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NARDA Model 7202
Microwave Unit Description

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SECTION I

MICROWAVE UNIT DESCRIPTION
NARDA Model 7202

1.1 INTRODUCTION .

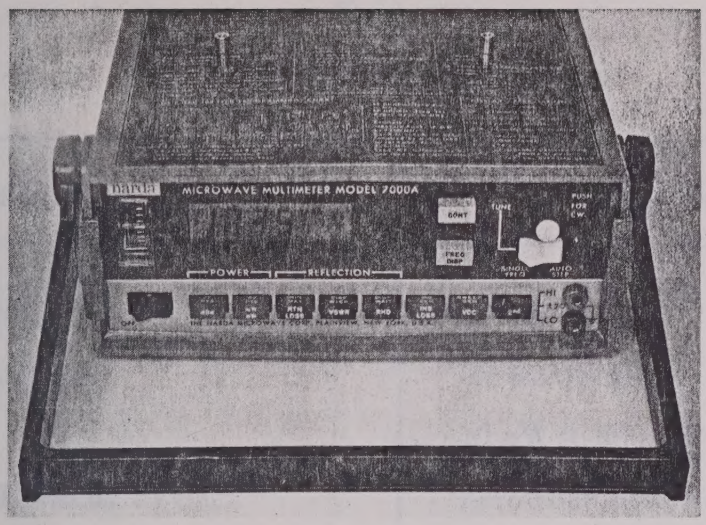
This manual, containing operation and maintenance instructions for the Model 7202 microwave unit designed and manufactured by Narda Microwave Corp., Hauppauge, N.Y. 11788, is divided into six sections. Section I presents a general description of the equipment including specifications. Section II covers operation, Section III describes theory of operation, Section IV gives maintenance procedures, Section V itemizes replaceable parts, and Section VI contains schematics and parts location drawings.

1.2 DESCRIPTION .

Narda's Model 7202 microwave unit, together with the Model 7000A microwave multimeter (as illustrated in Figure 1-1), provides a complete microwave laboratory when connected to an external microwave source. It performs precise microwave measurements over the frequency range of 0.01 GHz to 2.0 GHz. A microprocessor supplies instructions displayed on the 7000A's LCD readout enabling an inexperienced operator to use the system by simply following directions in the sequence given. The detector in the 7202 measures power from -50 to +13 dBm over a frequency range of 10 MHz to 18 GHz. The detector is digitally linearized by the 7000A. The calibration data for the detector is stored in a calibration PROM in the 7202. Digital linearization eliminates the drift associated with conventional segmented circuits. The Model 7202 requires an external source for insertion loss, gain and reflection measurements.

1.3 SPECIFICATIONS .

See Table 1-1 through 1-5 for microwave unit specifications and figures 1-2 and 1-3 for physical dimensions of the microwave unit's case and detector. Unless otherwise stated, parameters called out in Table 1-1 through 1-4 are stated at 23°C. It should also be noted that all 7202 power supply and control requirements are supplied by the 7000A. All specifications given are for a complete microwave multimeter system, consisting of a Model 7202 microwave unit and a Model 7000A microwave multimeter.



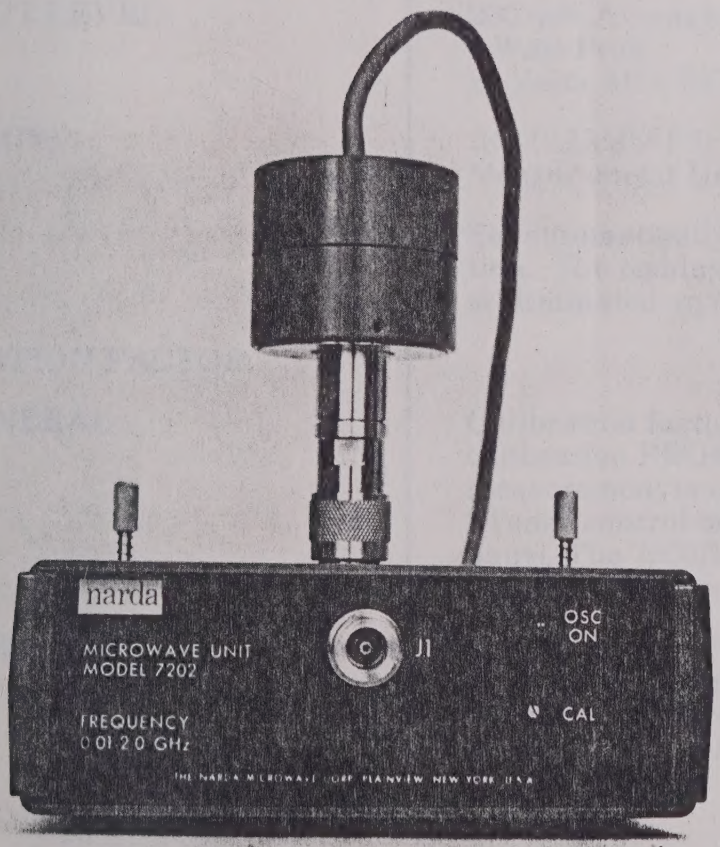


Figure 1-1. 7202 Microwave Unit and Multimeter

Table 1-1

Power Meter Specifications

Specification	Description
FREQUENCY:	0.01 to 18 GHz
POWER LEVEL:	-50 to +13 dBm 10 nW to 20 mW
POWER SENSOR TYPE:	Zero Bias Schottky
SENSOR VSWR:	≤1.50:1, .01 to .05 GHz ≤1.20:1, .05 to 4.0 GHz ≤1.4:1, 4 to 18 GHz
BURN OUT LEVEL:	200 mW Average For 1 Minute 1 Watt Peak 20 Volts AC + DC
ACCURACY:	±3% (0.15 db) For Instrument ± Measurememt Uncertainty*
ZERO:	Set automatically during calibration. The residual zero error is eliminated on every range.
CALIBRATION FACTOR:	
GENERAL	Calibration factor is stored in a calibration PROM. Frequency of the measurement is enterd with the "Tune" control on the 7000A front panel. The 7000A then automatically corrects the measured power.
FREQUENCIES	The calibration PROM contains calibration factors for 50 MHz and at every 1.024 GHz increment, starting at 1.024 GHz (19 total).

*Measurement Uncertainty = ± Mismatch Uncertainty ± Calibration Factor Uncertainty

TABLE 1—1 (Cont.)

Specification	Description
CALIBRATION FACTOR: (Cont) UNCERTAINTY	This calibration factor uncertainties are given below:

Frequency	Worst Case Uncertainty(%)	% Probable Uncertainty (RSS)
2.048	6.3	2.7
4.096	6.9	3.0
6.144	6.7	2.9
8.192	6.9	3.0
10.240	6.7	2.9
12.288	8.8	4.1
14.336	10.4	4.7
16.384	10.3	4.6
18.000	10.2	4.6

Table 1-2

Insertion Loss and Gain Measurement Specifications

Specification	Description
MEASUREMENT RANGE:	+13 to -50 dB for 0 dBm at test port
FREQUENCY RANGE:	0.01 - 2.0 GHz
TEST PORT VSWR:	1.20:1 Bridge only 1.30:1 Complete 7202 System 1.22:1 Complete 7202 System - Typical
INSERTION LOSS THRU 7202 (TEST SIG. IN TO J1)	10 db TYPICAL
AUTO-RANGING:	Instrument automatically selects optimum range.
AUTO-ZEROING:	Instrument zeros itself before each measurement.
SELF-CALIBRATING:	Calibration instructions are given to the operator when a calibration is required.
MEASUREMENT POINTS:	SINGLE FREQ: Repetitively makes measurements at one point. Continuously adjustable with "Tune" control. AUTO STEP: 12 or 52: 11 or 51 equally spaced fixed points plus variable single frequency point.*
ACCURACY:	±3% (±.15 dB) ± Mismatch Uncertainty
INSTRUMENT DISPLAY MODES:	Three Operator-Selectable Display Modes: 1. Display minimum and maximum data only 2. Display data at each point and then continue to next point 3. Display data at each point and wait for operator control before continuing.

*Operator-Selectable End Points

Table 1-3

Reflection Measurement Specifications

Specification	Description
DISPLAY MODES:	RETURN LOSS VSWR RHO
MEASUREMENT RANGE:	Return Loss: 0 to 35 dB VSWR :200 to 1.04 RHO :.99 to .018
FREQUENCY RANGE:	1.01to 2 GHz
TEST PORT VSWR:	1.20:1 Bridge 1.30:1 Complete 7206 1.22:1 Complete 7206 - TYPICAL
DIRECTIVITY:	40 dB
AUTO-RANGING:	Instrument automatically selects optimum range
AUTO-ZEROING:	Instrument zeros itself before each measurement
SELF-CALIBRATING:	Calibration instructions are given to the operator when a calibration is required.
MEASUREMENT POINTS:	SINGLE FREQ: Repetitively makes measurements at one point. Continuously adjustable with "TUNE" control. AUTO STEP: 12 or 52 points: 11 or 51 equally spaced points plus variable single frequency point.*
ACCURACY:	±3% (±.15dB) ± Mismatch Uncertainty ±Directivity Uncertaintly

erator-Selectable End Points

Table 1-3 (Cont)

Specification	Description
INSTRUMENT DISPLAY MODES:	Three Operator-Selectable Display Modes: 1. Display minimum and maximum data only 2. Display data at each point and then continue to next point 3. Display data at each point and wait for operator control before continuing.

Voltage Table 1-4
Voltage Output Specifications

Description	Value
TUNE (Tuning voltage for external sweeper) V tune at minimum frequency V tune at maximum frequency Linearity anking Output TTL Level	 0.0000 Volts ± .010V or -10.000 Volts ± .020V* 10.000 Volts ± .020V ± .010 Volts from best fit Straight Line (0-10V) ± .020 Volts from best fit Straight Line (-10-+10V) > 2.4 Volts when RF is off < 0.8 Volts when RF is on

*Depending upon setting of Internal Switch

Table 1-5
Environmental Specifications

Specifications	Description
Temperature:	Operating: 0 to 50 °C Non-Operating: -40 to + 60°C
Humidity:	0% to 95% relative humidity (non-condensing)
Altitude:	Operating 0 - 15,000 FT. Non-Operating 0 - 25,000 Ft.

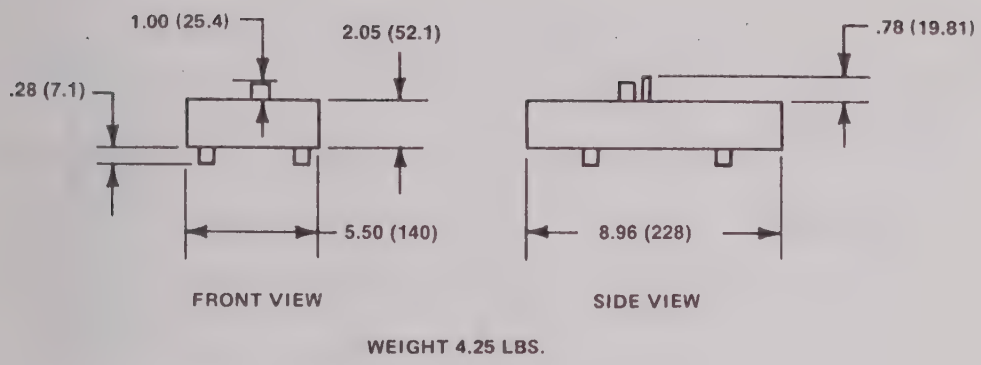


Figure 1-2. Microwave Unit Case Dimensions

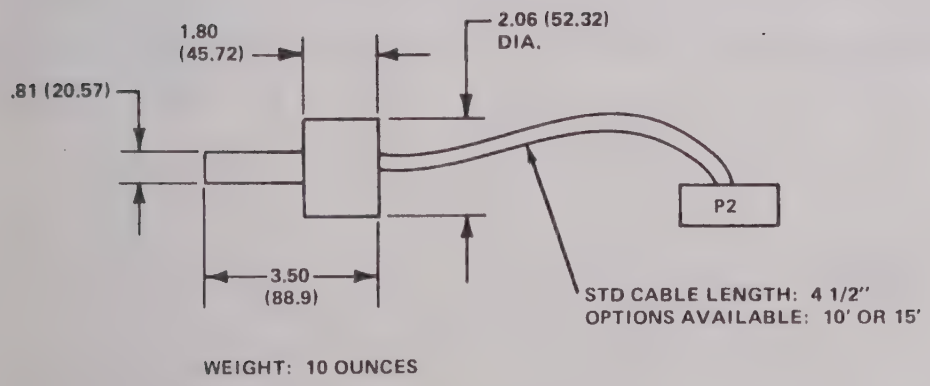


Figure 1-3. Detector Physical Dimensions

ACCESSORIES SUPPLIED .

Table 1-6 lists the accessories supplied with the Model 7202 microwave unit.

Table 1-6

Accessories Supplied with Model 7202

Item	Description	Model Number
1	Termination	379 BNM
2	Short/open Type N, male	231-416
3	Type N male to male	76
4	Short/open Type N, female	231-412

OPTIONS .

This section contains tables of connector options, accesssory kits, adapter ersion kits and accessory options for the Model 7202. In addition to these tables ns Narda offers a rack mounting storage drawer as a convenient storage place for owave units. It is Narda part number 106282. Table 1-7 lists the connector op- for the Test Port and Power Sensor along with the accessories supplied with each n. Table 1-8 lists the adapter conversion kits avilable and their use. Table 1-9 he components in the adapter conversion kits and Table 1-10 lists the optional sories for the Model 7202.

Table 1-7

Connector Options

Connectors			Standard Accessories					Option
Test Port	Coupled Port	Power Sensor	Load	Adapters Description	Adapter Model No.	Short/Open Description	Short/Open Model No.	Number
7 mm	N female	7 mm	379BNM	7mm-N male	5066	7 mm	5231	-21
N female	N female	N male	379BNM	N male/male	76	N female & N male	231-412 & 231-416	-22
7 mm	N female	N male	379 BNM	7 mm/N female	5067	7 mm + N male	5231 + 231-416	-23

NOTE: Model 7202 is supplied as standard with the following connectors:

Test Port (J1)	Type N female
Coupled Port (J2)	Type N female
Power Sensor	Type N male

Table 1-8

Adapter Conversion Kits

nnector otions	If the RF Head Connectors Are:			And you wish to perform measurements using:	Select Accessory Kits No.: (See Table 1-9)
	Test Port	Detector Port	Power Sensor		
FD	7 mm	N female	N male	Type N	1
FD	7 mm	N female	N male	SMA	2
1	7 mm	N female	7 mm	Type N	3
1	7 mm	N female	7 mm	SMA	4
2	N female	N female	N male	SMA	5
2	N female	N female	N male	7 mm	6
2	N female	N female	N male	Type N	7

Table 1-9

Accessory Kits

t No. ef. able 3)	Connector Type	Adapters	Short/Opens	No. Items
1	"N"	7 mm-N male, N female-N female	N female	3
2	SMA	7 mm-SMA female, 7 mm-SMA male N female-SMA male N female-SMA female	SMA male SMA female	6
3	"N"	7 mm-N female (2), 7 mm-N male	N male N female	5
4	SMA	7 mm-SMA male (2) 7 mm-SMA female (2)	SMA male SMA female	6
5	SMA	N male-SMA female, N male-SMA male N female-SMA female, N female-SMA male	SMA male SMA female	6
6	7 mm	7 mm-N male, 7 mm-N female	7 mm	3
7	"N"	N female - N female	-	1

Table 1-10

Optional Accessories For Model 7202

Item	Description	Model Number
Termination	Type N male	379 BNM
Termination	Type N female	379 BNF
Termination	7 mm	5379
Attenuators	Type N 3 dB	779T-3
	6 dB	779T-6
	10 dB	779T-10
	20 dB	779T-20
	30 dB	779T-30
	NOTE Adding a 5 in front of the model number changes the connector to 7 mm: e.g. 5779-10 is a 10 dB attenuator with 7mm connectors.	
Detector	Type N	503
Adapters	7 mm to Type N	
	N female to 7 mm	5066
	N male to 7 mm	5067
Adapters	SMA to Type N	
	SMA female to N male	55
	SMA male to N male	56
	SMA male to N female	57
	SMA female to N female	58
Adapters	Type N	
	N male to N female	76
	N female to N female	77

UNPACKING AND RESHIPMENT .

The following instructions should be carefully observed to avoid damage to nultimeter caused by transportation and handling.

. Unpacking. Unpacking of the Microwave Unit should be done with extreme . The equipment is normally shipped in a double cardboard carton and lined with n filler material for protection. Before opening, visually inspect the carton to ensure no damage has occurred during transit. If damaged, notify the shipping t immediately. If there is no evidence of damage, carefully unpack and remove the pment.

NOTE

It is suggested that the shipping container and packing material be stored for possible reshipment of the unit.

. Reshipment. When reshipping the unit, use the original packing material shipping container or a good commercial grade high density filler material oximately four inches (10 cm) thick and double high-burst cardboard carton.

. Packing. When packing the unit for reshipment, proceed as follows:

.1. Cover the bottom of the carton with filler material;

.2. Place the unit into the carton;

.3. Place filter material on all sides and top of the unit;

.4. Place sufficient material around all units being returned.

.5. Thoroughly seal the carton.

SECTION II

MICROWAVE UNIT OPERATION
NARDA Model 7202

2.1. INTRODUCTION .

This section contains initial inspection, preparation for use and storage drawer option assembly instructions. Front and rear panel features are discussed. Refer to Section II; Operation, of the 7000A Microwave Multimeter Operation and Maintenance Manual for all power requirements, line voltage selection, interconnect, turn-on and operational procedures.

2.2. INITIAL INSPECTION .

The Model 7202 was tested and inspected at the factory before shipment. Initially inspect the unit according to instructions in Section I, paragraph 1.6.1. of this manual. If any equipment is damaged, notify the Narda Microwave Corporation and the carrier, immediately.

2.3. PREPARATION FOR USE .

Before connecting the Model 7000A to any power source, connect the 37 conductor cable assembly (Narda part number 319067) between "TO MICROWAVE UNIT" located on the rear panel of the multimeter and the 37 pin receptacle marked "TO MODEL 7000A" located on the rear panel of the 7202. Consult the multimeter, Model 7000A, maintenance and operation manual for power requirements and line voltage selection. Use the Model 7202 microwave unit only with a multimeter that has been connected to its power source in accordance with the following **WARNING** notices, as appropriate:

WARNING

(If using the Model 7000A multimeter). Do not bypass the protective third wire ground when connecting the instrument to a power source, because this will defeat the safety feature.

WARNING

(If using the Model 7000A-01). Connect the chassis ground, located on the rear panel of the multimeter, to a good earth ground to prevent electrical shock.

RACK MOUNTED STORAGE DRAWER .

To assemble rack mounted storage drawer Narda part number 106282, ed as follows:

Attach slides to drawers.

Using the Rack Mounted Storage Drawer. Microwave units are attached e standoffs, using existing spring loaded screws located on the microwave The power sensor assembly should be mounted to the front of the microwave by using the J1 connector, to prevent damage.

PANEL FEATURES .

The front and rear panel features of Model 7202 shown in Figures 2-1 2-2 are described in Tables 2-1 and 2-2.

INTERCONNECT AND TURN-ON PROCEDURE .

Connect the system as shown in Figure 2-3. Select line voltage, power e and conduct preoperational checkout as directed in the Microwave Multimeter ual for the 7000A.

CAUTION

Do not use excessive force when mating connectors on the Microwave Unit. Cross threading, over-torquing or other damage to connectors may degrade system accuracy.

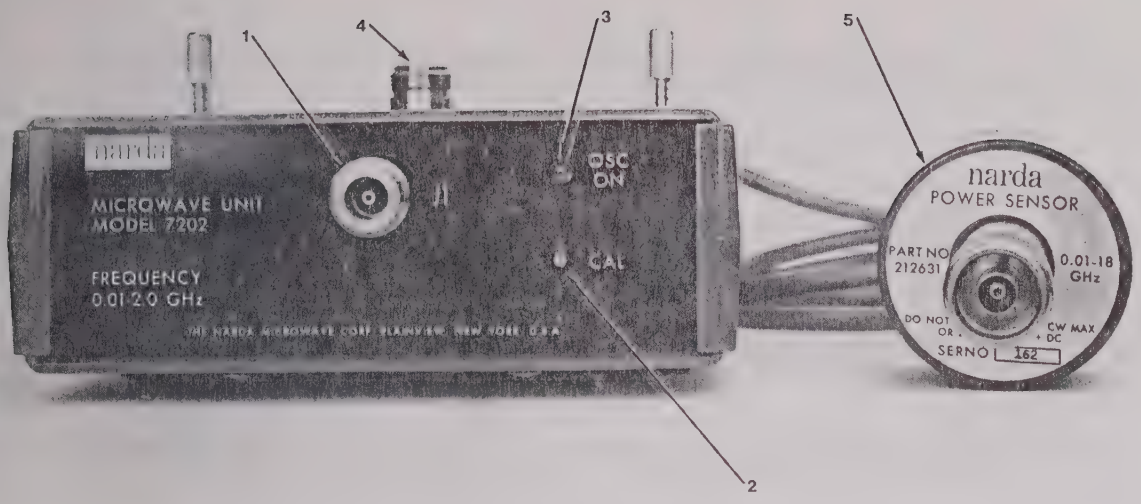


Figure 2-1. Model 7202 Front Panel

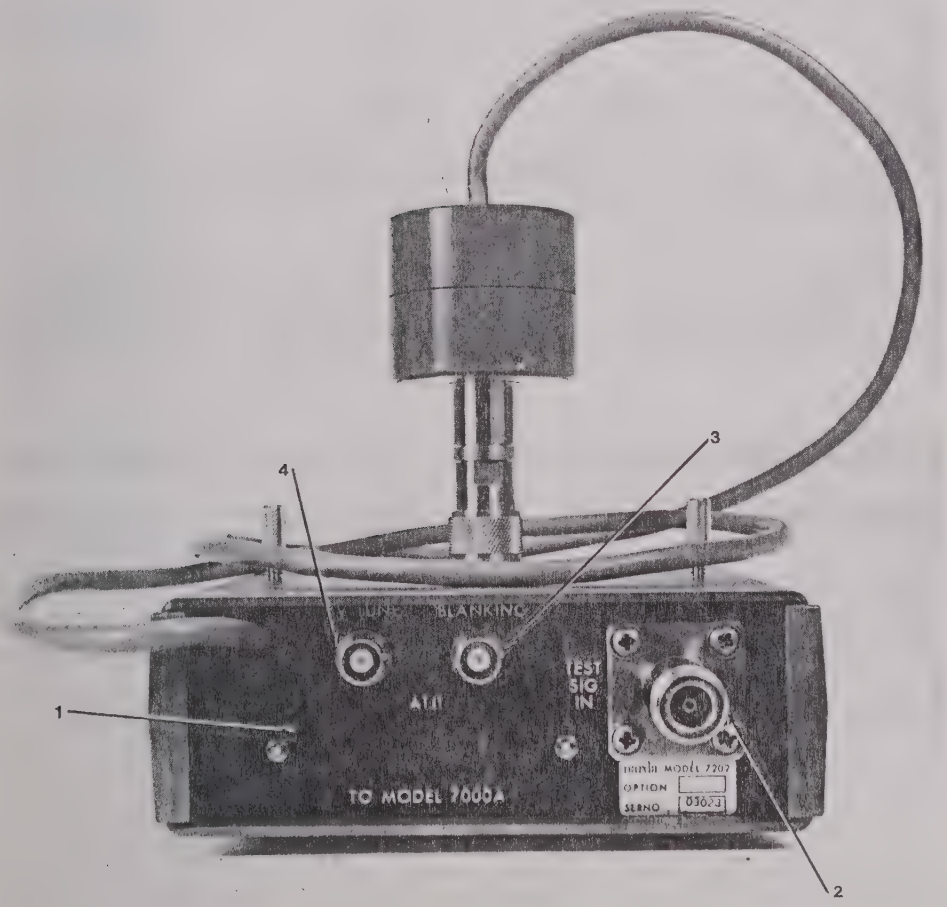


Figure 2-2. Model 7202 Rear Panel

Table 2-1

Front Panel Operating Control, Indicators and Connectors

e 2.1	Control/ Connector	Function
1	J1	Test port for Insertion Loss, reflection measurements, and output port for signal generator and SWEEP modes.
2	Cal.	Provides gain adjustment to calibrate the detector.
3	Osc. On	LED is on whenever the pin switch is on and unit is providing a test signal to the device under test.
4	J2	Detector port for Reflected Power.
5	Detector	Detects and amplifies RF and Microwave Signals.

Table 2-2

Rear Panel Connectors

e 2.2 No.	Connector	Function
1	To Model 7000A	Provides receptacle for interconnection with a 7000A through the 37 conductor cable, part no. 319067.
2	TEST SIG IN	Input port for external microwave source.
3	RF BLANK	Provides a blanking pulse to the external source.
4	V TUNE	Provides frequency tuning voltage for external microwave source.

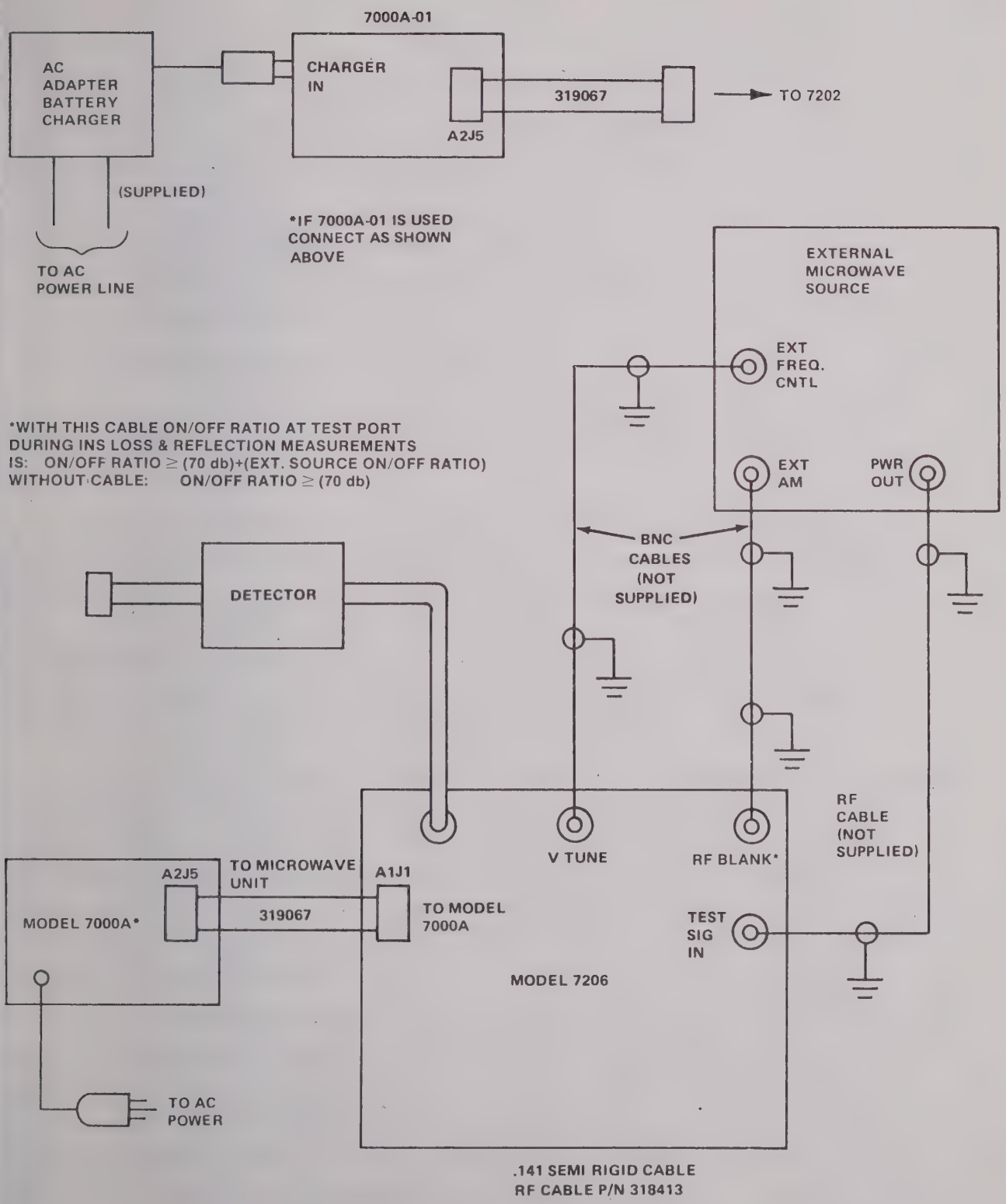


Figure 2-3. Interconnection Diagram: Model 7202 Microwave Unit with External Power Source

NOTE

For [SIG GEN] , [SWEEP GEN] or [FREQ DISP] modes, the 7000A's LCD will display a tuning voltage which corresponds to maximum and minimum frequency points of the Model 7202 Microwave Unit. The same display also occurs when using the 7202 during self check when the 7000A power is first turned on. To determine frequency, refer to paragraph 2.7.1.3.

EXTERNAL SIGNAL SOURCES .

Figure 2-4 shows front and rear panel HP8620C settings for use with Narda 7202 Microwave Unit. Table 2-3 gives sweeper programming information ther sweepers useable with the 7202.

. Using the HP 8620C; the Narda Model 7202 Microwave Unit is designed rectly interface to an HP 8620C sweeper main frame, and most other sweepers. necting the HP 8620C as shown in Figure 2-4 allows the 7000A to step the 3620C. All of the normal automatic control functions of the Narda 7000A are eved with this set-up except [SWEEP GEN] . The sweeper controls should be used broadband sweep or any sweep where band cross-overs will be encountered. re 2-4 also lists the required switch setting of the HP 8620C.

.1. The "V TUNE" output of the Model 7202 is either a voltage between zero and olts (0-10V position on S2) or a voltage between minus ten and plus ten volts (-10 - position on S2). Zero volts or -10V is the first step and +10 volts is the highest Internal switch, S2, is used to set the turning voltage range (see Figure 2-5). [SIG GEN] and "SINGLE FREQ" mode, this voltage is set by the TUNE control. This al is connected to the external frequency control input of the sweeper, programming nector pin 28, on the HP 8620C.

.2. In the MARKER SWEEP mode of operation the HP 8620C sweeps from the uency set on the START MARKER when V TUNE is zero volts to the frequency n the STOP MARKER when V TUNE is ten volts. Whenever AUTO STEP is ted on the 7000A, the V TUNE voltage tunes the HP 8620C sweeper in equally ed increments from the frequency set on the START MARKER to the frequency n the STOP MARKER, as long as MARKER SWEEP is selected. If FULL SWEEP

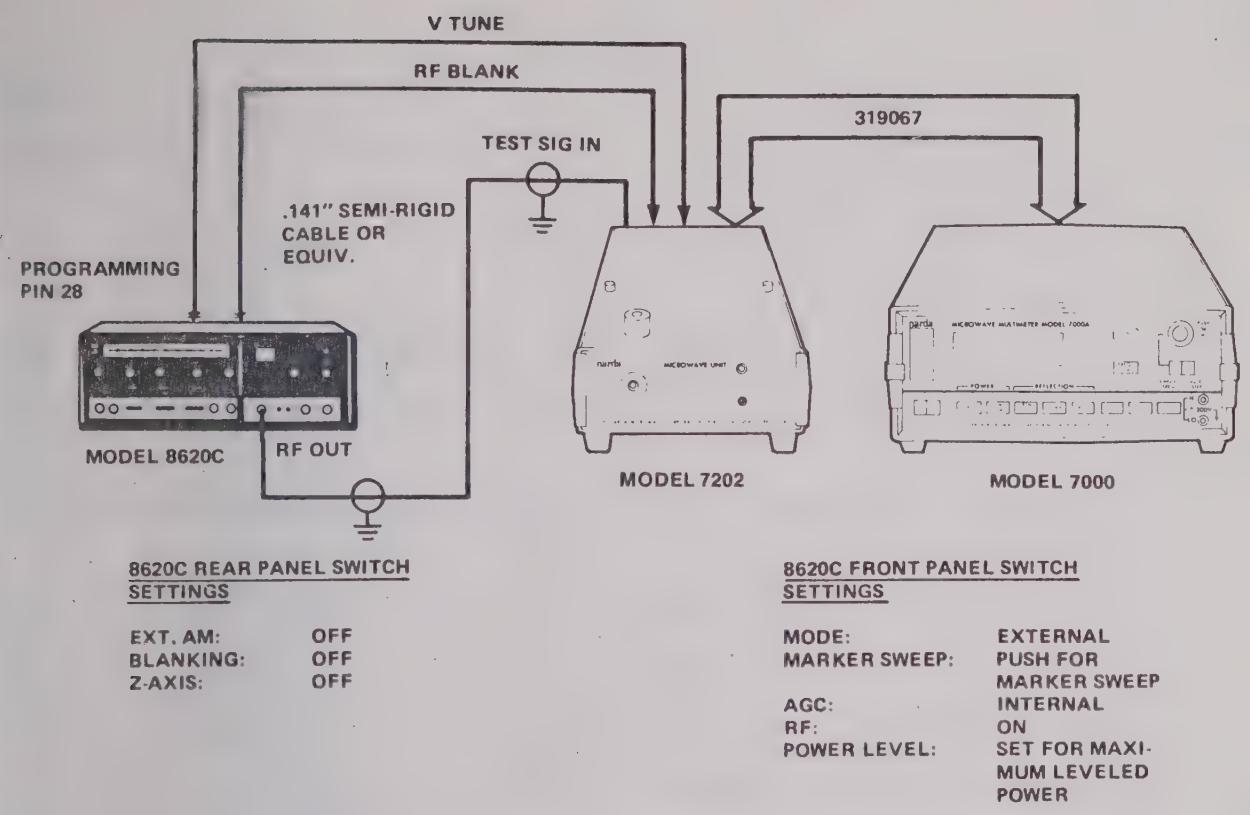


Figure 2-4. 8620C Front and Rear Panel Switch Settings

Table 2-3

External Frequency Programming, .01-2 GHz Sweepers

Sweeper	V Tune	Remarks
HP 8620C Series	0 to 10 Volts	Marker Sweep 0 Volts = Start Marker 10 Volts = Stop Marker Input PIN 28 - Programming Connector
Wavetek 2002A	-10 to +10 Volts	Input Programming PIN 14 Ground on Programming PIN 1 -10.0 V = Start of Band +10.0 V = End of Band

Table 2-3 (Cont)

Sweeper	V Tune	Remarks
on 6600 Series	0 to 10 Volts	Input thru rear panel BNC Marked "EXT SWEEP". The "INT-EXT" switch on ramp Generator (A2) PCB must be set to EXT position.
350A	0 to 10 Volts	Input thru front or rear "SWP" input BNC.

F is selected, the 7000A will tune the full band or Δ F segment selected on IP 8620C.

3. When a frequency is displayed on the 7000A, the display indicates the NE voltage. Because the HP 8620C cannot output the position of the markers 7000A, the actual frequency has to be computed. For example, suppose the RT MARKER is at 0.5 GHz and the STOP MARKER is at 1.5 GHz and the display ates a frequency corresponding to 2 volts. The sweep is 1 GHz wide, therefore, ning sensitivity is 1.0 GHz = 0.1 GHz/Volt.

lts

orresponding frequency is:

F = START FREQUENCY + (VOLTS INDICATED) x (TUNING SENSITIVITY)

ıe above example:

F = 0.5 GHz + (2 VOLTS) x (0.1 GHz/VOLT) = 0.7 GHz

can be computed automatically in the REMOTE Mode by the IEEE 488 bus oller.

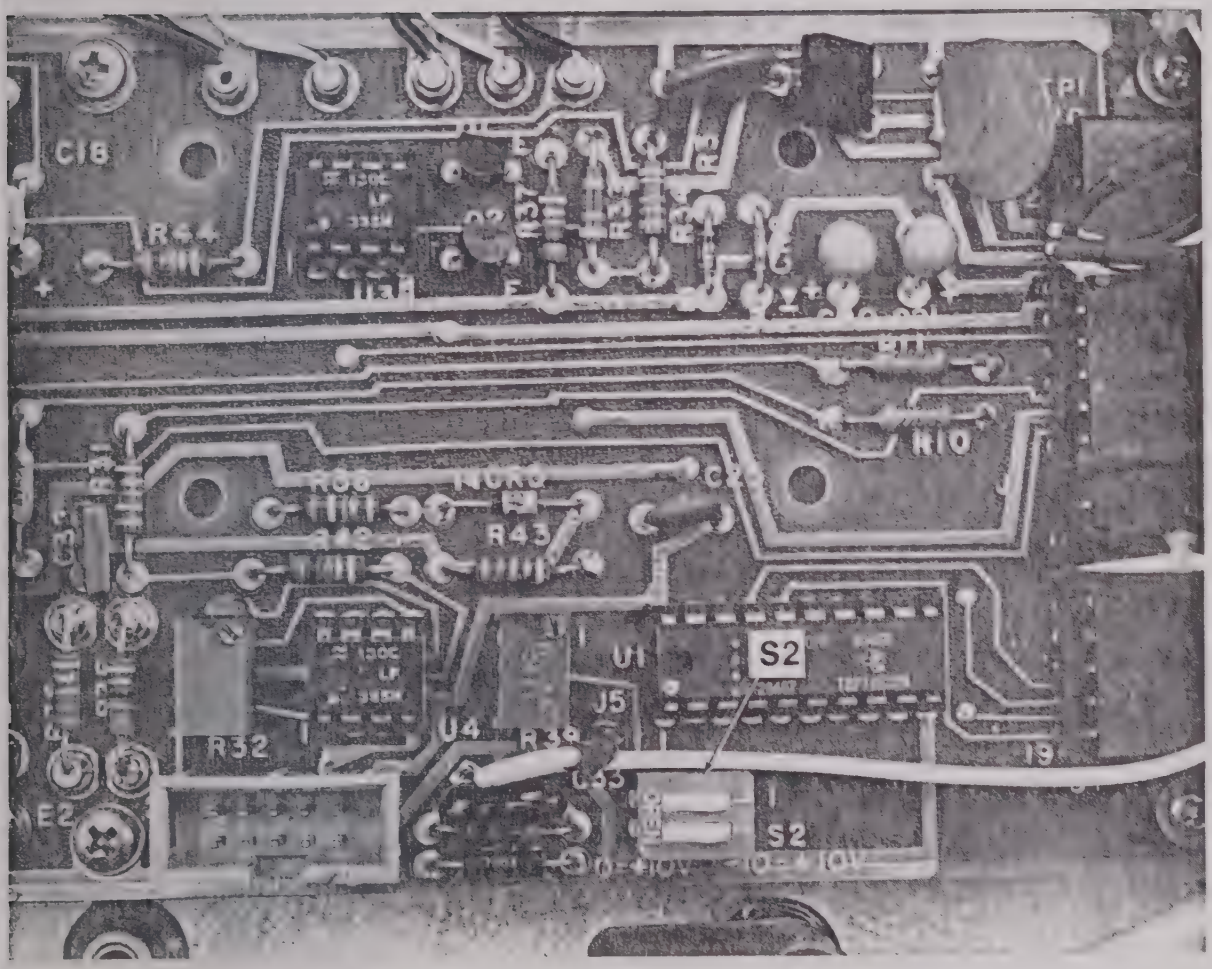


Figure 2-5: Internal View of 7202

SECTION III

MICROWAVE UNIT THEORY OF OPERATION
NARDA Model 7202

3.1. INTRODUCTION .

This section discusses the theory of operation specific to the Model 7202 Microwave Unit. All theory concerned with operating the 7202 as part of the complete measurement system, will be found in Section III of the Microwave Multimeter's Operation and Maintenance Manual.

3.2. DESCRIPTION .

The Model 7202 Microwave Unit consists of a .01-2.0 GHz high directivity bridge, a .01-2.0 GHz PIN switch, a .01 to 18 GHz zero bias schottky detector and electronics needed to control and calibrate these devices. See Figure 3-1 for a block diagram of the microwave unit.

3.2.1. The microwave signal from an external source is sent to the PIN switch which is in series with the .01-2.0 GHz bridge. The pin switch is turned on and off by the microprocessor in the 7000A, with the OSC OFF signal to the bias control cirucit. The frequency of the external source is controlled by the V TUNE signal. When the switch is on, the microwave signal passes through the PIN switch and through a rear panel interconnect cable into the bridge.

3.2.1.1. The .01 to 2.0 GHz bridge is used instead of a high directivity coupler because of its higher directivity (40 dBmin) over a broad frequency range (.01-2 GHz).

3.2.1.2. The detector is a zero bias schottky diode sensitive to very low power levels. The output of the detector is connected to a chopper/amplifier to provide high AC gain and good rejection to DC drifts typical of high gain circuits. The first stage of this amplifier is divided between the detector head and the RF board inside the micorwave unit.

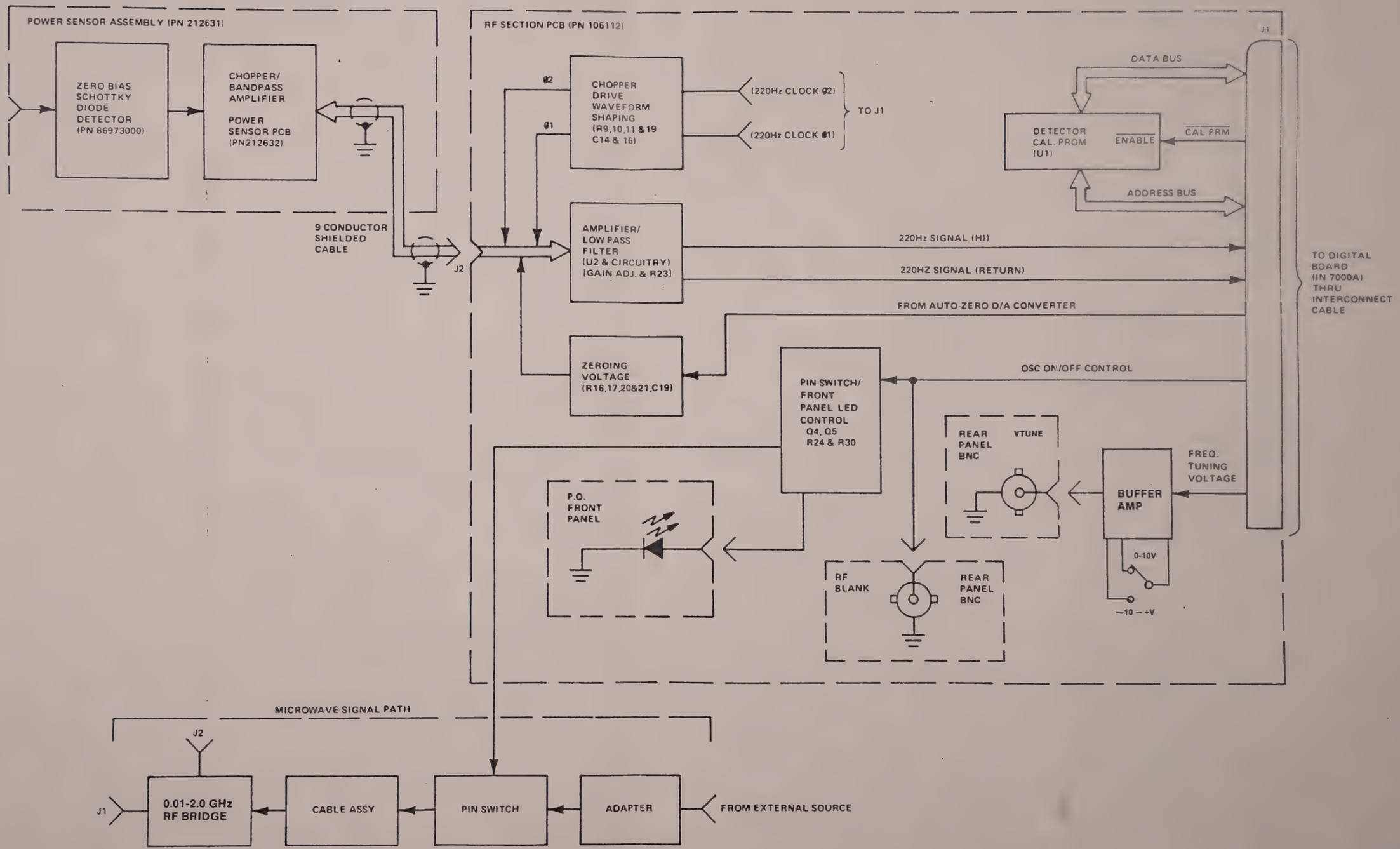


Figure 3-1. Block Diagram, Model 7202 Microwave Unit

3.2.1.2.1. Calibration data for the detector is stored in the calibration PROM mounted on the RF board (Figure 3-1).

3.3. MISMATCH UNCERTAINTY .

The total accuracy of a measurement is the combination of instrument accuracy plus measurement uncertainty. Errors or uncertainties are introduced with the measurement or calibration of equipment because of the mismatch of devices when connected together. These mismatches are present because any device being measured or any device performing the measurement is not an ideal 50 ohm impedance. Therefore, mating together various devices, each with an imperfect VSWR or "mismatch," causes an uncertainty. The uncertainty results because the mismatch of a device prevents it from absorbing all the power incident upon it. These uncertainties exist for power, insertion loss or reflection measurements and are described in detail under paragraphs 3.3.1., 3.3.2. and 3.3.3.

3.3.1. Mismatch Uncertainty for Power Measurement. The following equation describes mismatch uncertainties caused by the reflection coefficient of the power sensor and the source of power being measured. (ref. Figure 3-3.)

$$MU = 20 \log (1 \pm \rho_g \cdot \rho_D)$$

Where MU = Mismatch Uncertainty (maximum) in dB.

ρ_g = Generator Reflection Coefficent, RHO.

ρ_D = Detector Reflection Coefficient, RHO.

For the detector used in the Narda Model 7202, see Table 3-1 for worst case uncertainties when making power measurements of a power source having the VSWR's listed.

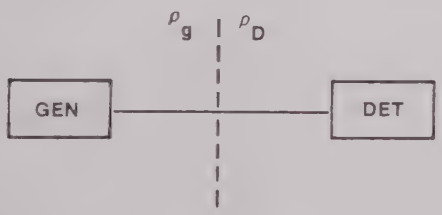


Figure 3-2. Power Meter Measurement Set-up

Table 3-1
Power Meter Measurement Uncertainty

VSWRg	ρ_g	Freq. ≤ 4 GHz (ρ_D = 0.091)	4 GHz ≤ Freq. ≤ 18 GHz (ρ_D = 0.157)
1.10:1	.048	± .04 dB	± .07 dB
1.20:1	.091	± .07 dB	± .13 dB
1.50:1	.200	± .16 dB	± .30 dB
2.00:1	.333	± .26 dB	± .50 dB

. Reflection Measurement Uncertainty. A typical reflection measurement p is shown in Figure 3-4. The measurement uncertainty of this set-up, in terms measurement of reflection coefficient RHO, is:

$$MU = d \pm \left[\left(\frac{\rho_g \cdot T^2 + \rho_1}{1 - \rho_g \rho_2} \right) \cdot \rho_L^2 \right]$$

ch is in the form:

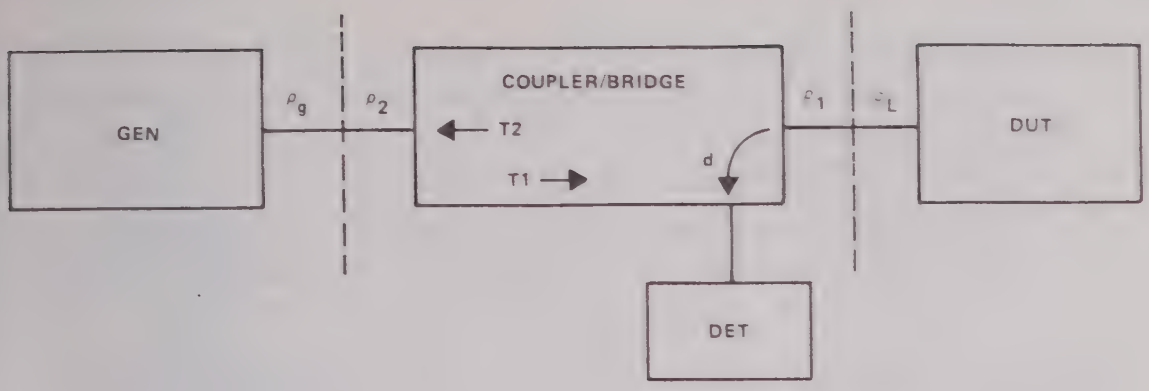
Total Uncertainty = Uncertainty caused by bridge directivity
± uncertainty caused by test port impedance

.1. Substituting the 7202 specification (d = .010, ρ, = 0.13) into the equation simplifying, yields the following equation:

$$MU = \pm .010 \pm \left(0.13 \cdot \rho_L^2 \right)$$

.2. Using the equation in paragraph 3.3.2.1., reflection uncertainties for lel 7202, as listed in Table 3-2 may be developed.

.3. By noting that the equation for MU is the sum of the uncertainty caused by ge directivity plus the uncertainty caused by the impedance of the bridge and erator, it can be shown that the impedance causes a very significant part of the ertainty for measurements of high reflection coefficient and that the bridge ctivity is most significant for low values of reflection coefficient.



$T_{1\&2} \equiv$ Through transmission of coupler/bridge $= 10^{\left(\frac{-\text{Ins. Loss In dB}}{20}\right)}$

$d \equiv$ Directivity of coupler/bridge $= 10^{\left(\frac{-\text{Directivity In dB}}{20}\right)}$

DUT $\equiv$ Device under test

Figure 3-3. Typical Reflection Measurement Set-up

Table 3-2
Reflection Uncertainty For Model 7202

Actual VSWR	$MU_{(VSWR)}$	Actual Return Loss	MU RTN Loss	Actual ρ	MU (ρ)
1.11:1	+.02 -.03	26.0	+2.0 -1.6	.05	±.010
1.22:1	±.03	20.0	+1.0 - .9	.10	±.011
1.50:1	±.05	14.0	± .7	.20	±.015
1.85:1	+.10 -.08	10.5	± .6	.30	±.021
2.00:1	+.11 -.10	9.6	± .6	.333	±.024

NOTE

Reflection uncertainty is calculated using the following identities:

$$\text{RTN LOSS} = 20 \log \text{RHO}$$

$$\text{VSWR} = \frac{1 + \text{RHO}}{1 - \text{RHO}}$$

.4. It should be noted that measurement uncertainty for a typical 7202 will nsiderably lower than shown in Table 3-2 for the following reasons: First, the ılations shown in this discussion are based on worst case specification instead pical performance. Second, the directivity of the bridge typically increases increasing frequency while the impedance matching typicaly decreases with easing frequency. Hence, the worst case directivity will very rarely occur at ame frequency as the worst case impedance matching.

. Transmission (Insertion Loss/Gain) Measurement Uncertainty. A similar ysis can be done for transmission measurements. When the system is calibrated, e is a mismatch error in the calibration measurement. Figure3-5 shows this p. Then, when the device under test is inserted, there are mismatch errors oth interfaces as shown in Figure 3-6.

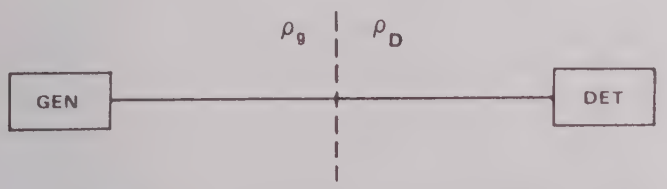


Figure 3-4. Calibration Mismatch Error

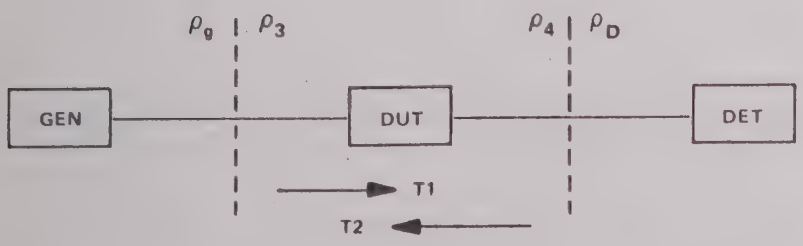


Figure 3-5. Transmission Test Mismatch Error

3.3.3.1. The total uncertainty equation for transmission (insertion loss/gain) is:

$$MU = 20 \log \left[\frac{1 \pm (\rho_g \cdot \rho_D)}{(1 \pm \rho_g \cdot \rho_3)(1 \pm \rho_4 \cdot \rho_D) \pm (T_1 \cdot T_2 \cdot \rho_g \cdot \rho_D)} \right]$$

.3.3.1.1. To determine the accuracy of the measurement, it is essential to know the eflection coefficients of all components involved.

.3.3.1.2. By substituting the 7202 specifications, mismatch uncertainties for transmission measurements can be reduced to:

$$MU = 20 \log \left[\frac{1 \pm .026}{(1 \pm .13.\rho_3)(1 \pm .20.\rho_4) \pm .026.T_1.T_2} \right] \text{ at Freq} = .010\text{-}.050 \text{ GHz}$$

$$MU = 20 \log \left[\frac{1 \pm .012}{(1 \pm .13.\rho_3)(1 \pm .09.\rho_4) \pm .012.T_1.T_2} \right] \text{ at Freq} = .05\text{-}2.0 \text{ GHz}$$

Where ρ_3 = Input reflection coefficient of device under test
ρ_4 = Output reflection coefficient of device under test
T_1 = Forward transmission ratio of device under test
T_2 = Reverse Transmission ratio of device under test

See Table 3-3 for transmission measurement uncertainties developed by using these equations.

Table 3-3

Typical Transmission Measurement Uncertainties For Model 7202

Device Under Test		MU (dB)	
Description	Input/Output VSWR (ρ)	.01-.05 GHz	.05-2.0 GHz
tenuator: 30 dB	1.10:1 (.05)	± .36	± .19
tenuator: 10 dB	1.10:1 (.05)	± .38	± .20
tenuator: 10 dB	1.20:1 (.09)	± .51	± .29
tenuator: 6 dB	1.20:1 (.09)	± .55	± .31
tenuator: 3 dB	1.20:1 (.09)	± .60	± .33

. Measurement uncertainties given in Table 3-3 are based on minimum ations rather than on typical performance. The typical 7202 will therefore nsiderably lower measurement uncertainties, than those shown.

SECTION IV

MICROWAVE UNIT MAINTENANCE
NARDA Model 7202

4.1 INTRODUCTION .

Before starting maintenance, perform the "Interconnect and Turn-on Procedures described under paragraph 2.6 in Section II of this manual, and check Table 4-1 for a list of required test equipment. If additional schematic or parts location information is needed for maintenance purposes, refer to Section VI of this manual.
It is suggested that the 7202 and 7000A be calibrated together to save time.

4.2 FUNCTIONAL AND ACCURACY TESTS AND ADJUSTMENTS.

The multimeter (7202 Microwave Unit + 7000A or 7000A-01) that passes all functional and accuracy checks is fully operational to original manufacturer's specifications and may be returned to service. Adjustments describe the procedure for aligning a unit that passes functional tests but does not meet accuracy specifications.
These tests will systematically test one or several functional blocks of the 7202 at a time while adding a minimum number of new functional blocks with each new test.
The tests were designed this way to make troubleshooting the system easier, should a fault be found.

4.2.1 Calibrating a 7202 and 7000A (or 7000A-01) Together. When calibrating a 7202 Microwave Unit and multimeter together, refer to the microwave multimeter manual Section IV, paragraph 4.2. The functional and accuracy tests and adjustments described there, will calibrate most of the 7202 and all of the 7000A (or 7000A-01). After successfully completing all tests in the microwave multimeter manual, go to paragraph 4.2.6, insertion loss and isolation through the 7202, in this manual, to complete the calibration of the 7202 Microwave Unit.

4.2.2 Calibrating a 7202 with a Calibrated 7000A (or 7000A-01). When calibrating a 7202 Microwave Unit with a calibrated multimeter, follow the procedures that begin under paragraph 4.2.3, preliminary instructions, in this manual.

Table 4-1
Required Test Equipment

tm o.	Description
	7000A
	7000A-01
	37 PIN Interconnect cable (W1) NARDA P/N 319067 supplied with the multimeter
	4 1/2 digit DVM. Data Precision 2480R or equivalent
	Signal Generator, 2-18 GHz, HP 8620C w/86290 BRF Plug-In, or equivalent
	Oscilloscope, with external sweep input capability. TEK 454 or equivalent
	Frequency Counter, 5Hz-18 GHz, EIP 351 or equivalent
	Crystal Detector. Narda Model 503 or equivalent
	Two BNC cables four feet long. Narda Model SBNCB-48
	Source, + 10.0 mW ± .10 mW, 50 or 100 MHz
	Source + 1.0 mW ± .01 mW, 50 or 100 MHz
	RF Source, Power out ≥ 100 mW, 50 or 100 MHz HP8601 or equivalent
	Step Attenuator, 0-90 dB in 10 dB steps. HP 355D,option.001,or equivalent
	Step Attenuator, 0-9 dB steps. HP 355C option,.001, or equivalent
	Power Meter
	Attenuator, 10 or 20 dB, w/known VSWR and Insertion Loss, .01-2.0 GHz (for Insertion Loss and Reflection Measurement tests)

4.2.3 Preliminary Instructions. Following interconnect procedures outlined in paragraph 2.6 in Section II of this manual. Before turning on the power switch, remove the top cover of the 7202 Microwave Unit by the following procedure:

4.2.3.1. Remove the four phillips head screws from the feet located on the bottom surface of the 7202 Microwave Unit.

4.2.3.2. Press down on the upper surface of the side bezel while carefully prying the top from the body, to avoid complete disassembly of the 7202 case.

4.2.3.3. Set power switch to "ON" position. Over a period of approximately five seconds the LCD readout will display all segments illuminated as shown in Figure 2-7, Section II of the 7000A manual, followed by a brief display of the minimum and then maximum rated Tuning Voltages (0 and 10 Volts) of the 7202 Microwave Unit.* During this time, the multimeter performs an internal self-test of the microprocessor, internal memories and program integrity. After these internal tests have been completed, the LCD readout will indicate that the multimeter is in the Volts mode. The LCD readout will display 0.000 plus or minus .003 volts.

4.2.3.4. If the multimeter does not turn on, check the line voltage and fuse as outlined under paragraph 2.5 in Section II of the 7000A manual.

*When using a 7000A with Serial Number ≥4000 and option-02 the bus address of the instrument will be displayed after the maximum tuning voltage.

.4 Power Meter Test. Perform the following test to verify accuracy of the ver meter section.

NOTE

This test checks the accuracy of both the 7000A multimeter and 7202 Microwave Unit, combining both accuracies under the heading of 7000A microwave multimeter accuracy.

.4.1. Connect the equipment as shown in figure 4-1.

.4.2. Turn the reference power source off.

.4.3. Press [ ] then [ ] and [ ] on the 7000A to select the power ter mode. Press [CONT] to cause the multimeter to auto zero.

.4.4. Turn the "TUNE" pot on the front panel of the multimeter fully nterclockwise and press [CONT] then press [ ] to select the lowest frequency ibration factor (50 MHz).

.4.5. Turn the reference power source on.

.4.6. Adjust the calibration pot (CAL) on the front panel of the microwave unit til the correct input power is read on the multimeter's LCD. This adjustment should a maximum of 2 to 3% change.

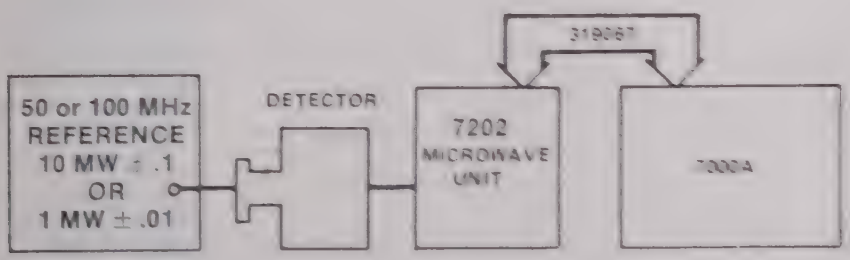


Figure 4-1. Power Meter Calibration/Gain Test

4.2.4.7. Power Meter Linearity Test. Connect the equipment as shown in Figure 4-2 (or 4-2A) and proceed as follows:

4.2.4.7.1. Press [dBm], then press [2nd] and [CALIB]. Follow calibration instructions.

4.2.4.7.2. Set the 10 dB step attenuator to 10 dB and adjust the signal source for 10.00 dBM, as read on the multimeter's LCD.

4.2.4.7.3. Use both step attenautors to set values in 2 dB steps, from 10 dB to 70 dB and note that the multimeter reads the computed power levels to within the test set up and multimeter accuracies. Refer to 4.2.4.7.4. for Total Uncertainty Computation. The accuracy specification for the multimeter with a calibrated microwave unit is ± 3% (± .15 dB) (assuming 0% calibration factor error). The total accuracy of the entire test setup shown in Figure 4-2 is ± .72 dB including step attenuator accuracy.

NOTE

There are no range to range accuracy adjustments on the microwave unit. If accuracy is not within specified limits, the detector and/or the detector cal PROM must be changed. See Table 4-2 for the memory map of detector calibration PROM.

4.2.4.7.4. Total Uncertainty Computation For Power Meter Linearity Test.

Total uncertainty = Calibration test system uncertainty + 7000A uncertainty
Total uncertainty = [attenuation uncertainty of 1 dB step attenuator + attenuation uncertainty of 10 dB step attenuator + mismatched uncertainty of test port.]+[7000A uncertainty]

Substituting in the specifications for the listed equipment:

Total uncertainty = [±.25 dB (1 dB step) ± .25 dB (10 dB step) ±20 log $(1 + \rho_g \rho_D)$] ±[.15 dB (7000A)]

Where: ρ_g = reflection coefficient at the test port (10 dB step atten.).
ρ_D = reflection coefficient of the detector
(specification for ρ_g and ρ_D = .09)

Total uncertainty = [± .25 dB ± .25 dB ± .07 dB] ± .15 dB
Total uncertainty = ± 0.57 dB ± .15 dB = ±.72 dB

Example: Step Attenuator at 32 dB
Calculated reading = + 10 dBm - (Δ step attenuation*)
= + 10 dBm - (22 dB)
= −12.0 dBm
therefore, the 7000A should read −12.0 dBm ± 0.7 dB

tep attenuation is the difference between the step attenuator setting and the 10 dB was used to set the reference +10 dBm level.

7.5. Total system uncertainty may be substantially reduced by calibrating the ttenuator at the calibration frequency before calibrating the multimeter. ring to the total uncertainty computation in 4.2.4.7.4., ± .5 dB of the total ± .57 dB ation test system uncertainty is caused by attenuation uncertainty.

7.6. A further reduction in calibration uncertainty may be made by adding a 10 dB attenuator having a reflection coefficent ≤ .02 between the detector of the wave unit and the 10 dB step attenuator. Narda fixed attenuators, 779 Series, ally have reflection coefficients of ≤ .02 at RF frequencies. Paragraph 4.2.4.7.7. des an example of calibration uncertainty reduction.

7.7. As an example, if the test set up of Figure 4-2A is used and is calibrated to an acy of ±.07 dB the accuracy of measurement can be improved to ± .09 dB. ituting in the equation under paragraph 4.2.4.7.4.:

Total uncertainty = [±atten uncertainty ± 20 Log $(1 \pm \rho_g \cdot \rho_D)$] ± 7000A uncertainty
= [± .07 ± 20 Log (1 ± (.02 x .09))] ± .15 dB
= [± .07 ± .02] ± .15 dB
= ± 0.24 dB

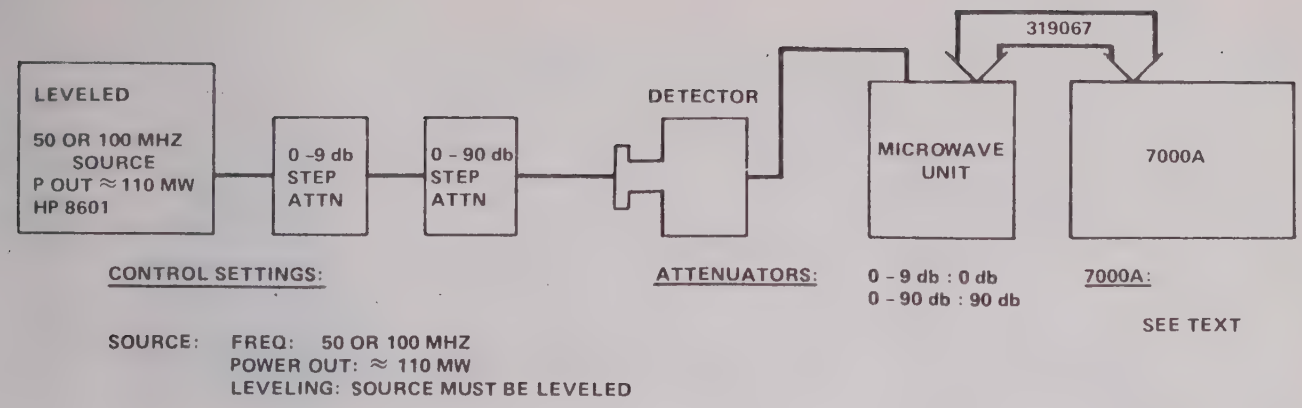


Figure 4-2. Power Meter Linearity Test

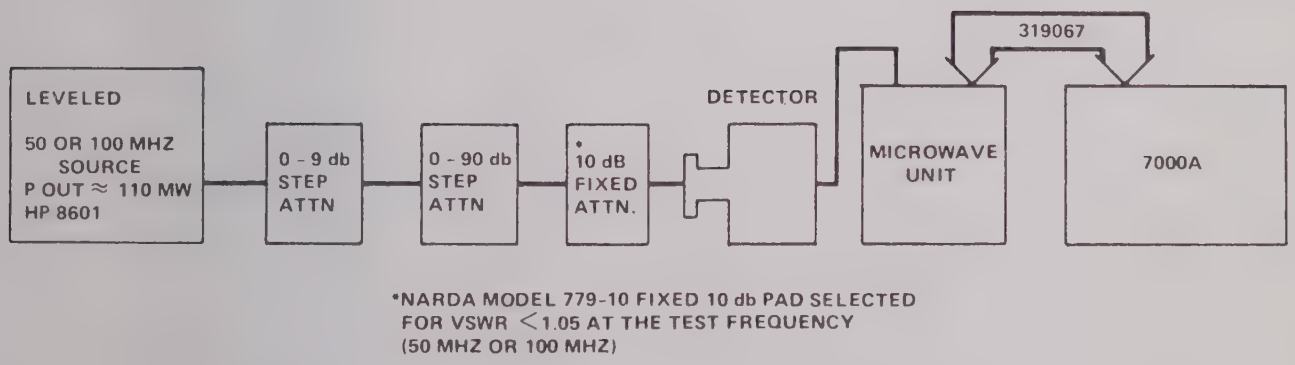


Figure 4-2A. High Precision Power Meter Linearity Test

Table 4-2
Detector Calibration Prom (U1) Memory Map

ress	Data Function	Typical Data
	Calibration Factor at 50 MHz	100*
	Calibration Factor at 1.024 GHz	99
	Calibration Factor at 2.048 GHz	98
6	Calibration Factors for 3.072 GHz to 16.384 GHz (every 1.024 GHz)	99 - 90 general trend is decreasing
	Calibration Factor for 17.408 GHz	92
	Calibration Factor for 18.0 GHz	90
20	Repeat of Calibration Factor for 18.0 GHz	90, 90
22	Detector Voltage for -30.0 Bm (1.00 μW)	24*
24	Detector Voltage for -28.0 dBm **	38*
26	Detector Voltage for -26.0 dBm	60*
28	Detector Voltage for -24.0 dBm	95
30	Detector Voltage for -22.0 dBm	146
32	Detector Voltage for -20.0 dBm (10.00 μW)	230
34	Detector Voltage for -18.0 dBm	350
36	Detector Voltage for -16.0 dBm	550
38	Detector Voltage for -14.0 dBm	800
40	Detector Voltage for -12.0 dBm	1,200
42	Detector Voltage for -10.0 dBm (100 μW)	1,700
44	Detector Voltage for - 8.0 dBm	2,400
46	Detector Voltage for - 6.0 dBm	3,400
48	Detector Voltage for - 4.0 dBm	4,600
50	Detector Voltage for - 2.0 dBm	6,300
52	Detector Voltage for 0.0 dBm (1.00 ηW)	8,400
54	Detector Voltage for + 2.0 dBm	11,100
56	Detector Voltage for + 4.0 dBm	14,600
58	Detector Voltage for + 6.0 dBm	19,200
60	Detector Voltage for + 8.0 dBm	24,800
62	Detector Voltage for +10.0 dBm (10.00 ηW)	32,000
64	Detector Voltage for +12.0 dBm	40,000
67	For Narda internal Bookkeeping - not used by Multimeter	--
251	Not used	255 (unprogrammed)

This data is exact for all 7202's.
Detector Voltage data is used by the 7000A to correct for the changing gain of the ctor as it goes its square law region to its linear region as power increases. See the)A's manual, Section III, for the theoretical discussion.

Table 4-2 (Cont)

The equation for Detector Voltage is:

$$\text{Detector Voltage} = \left(\frac{\Delta \text{ Voltage at Comparator of 7000A}}{\text{GAIN REFERENCE}}\right) \times 24576$$

where Δ Voltage at comparator = Voltage at A3, U15, Pin 3 with Power Applied - Voltage at A3, U15, Pin 3 with no Power Applied (in the Same Range)

and GAIN REFERENCE = 1024 for Power ≈ -38 to -27 dBm
256 for Power ≈ -27 to -21 dBm
64 for Power ≈ -21 → -15 dBm
4 for Power ≈ -15 → dBm
1 for Power ≈ +4 → +12 dBm

NOTE

1. Δ Voltage at comparator is set for 1.000V at a power level of 1.000 μw (-30.0 dBm) using the Cal. adjust control on the 7202. This is consistent with the Detector Calibration PROM Memory Map, in that: Detector Voltage $= \frac{1.000V}{1024} \times 24576 = 24$ which is always true at -30.0 dBm for the 7202.

2. The maximum and minimum levels for a given range (i.e. gain reference) will vary approximately ±1 dB from unit to unit depending upon the shape of the volts vs. power input for the 7202's detector. See the 7000A's theory of operation, Section III, for the discussion of this curve.

2.5. Signal Generator Test. After completing the power meter test, perform the lowing test to verify accuracy of the signal generator section.

2.5.1. Connect the equipment as shown in Figure 4-3, and proceed as follows:

2.5.2. Press [VDC] and note that the "OSC ON" LED located on the microwave it's front panel is off.

2.5.3. Press [2nd] and [SIG GEN] and note that the "OSC ON" LED is now on.

2.5.4. Press [INS LOSS] then [2nd] and then [52 PTS] . Press [2nd] and en [DISP WAIT] . Press [INS LOSS] then [2nd] and then [CALIB] . Remove the detector from y source of RF power and then press [CONT] twice.

2.5.5. After "dut" is displayed on the multimeter's LCD, press [CONT] and set S2 (Rocker Switch, 2P2T) to 0→10V position. The DVM should now read 0.000 Volts 0 mV. Adjust A1R32 (offset) for compliance.

2.5.5.1. After two seconds have elapsed, press [CONT] again. The voltage read on e DVM should be 0.200 ± .040 volts.

2.5.5.2. Repeat 4.2.5.5.2. until the voltage read is 10 volts and note that the voltage es by 200 mV for each step. Each step should be within 40 mV of the nominal pected voltage except for the 10.00V step which should be within 20 mV.

2.5.5.3. Set A1S2 to -10→+10V position. Press [INS LOSS] . The DVM should now read .00V ± .150V. Adjust A1R39 (minus 10V offset) for complaince.

2.5.5.4. After two seconds have elapsed, press [CONT] . The voltage read on the VM should be 9.600 ± .190 V.

2.5.5.5. Repeat 4.2.5.5.4. until the voltage read is 10 Volts and note that the voltage es by 400 mV for each step. Each step should be within 190 mV of the nominal pected voltage except for the 10.0V step which should be within 150 mV.

2.5.5.6. Reset A152 to the 0 → 10V position then press [CONT] and rotate the UNE" control knob on the front panel of the multimeter from full counterclockwise to l clockwise. The voltage read on the DVM should vary from 0.00V ± 50 mV to at st 10.0V. There are no adjustments for the "TUNE" control potentiometer.

2.5.5.7. Press [2nd] and [MIN MAX] . This will clear the multimeter of the [DISP WAIT] de. Set A1S2 to the position required for the external source being used.

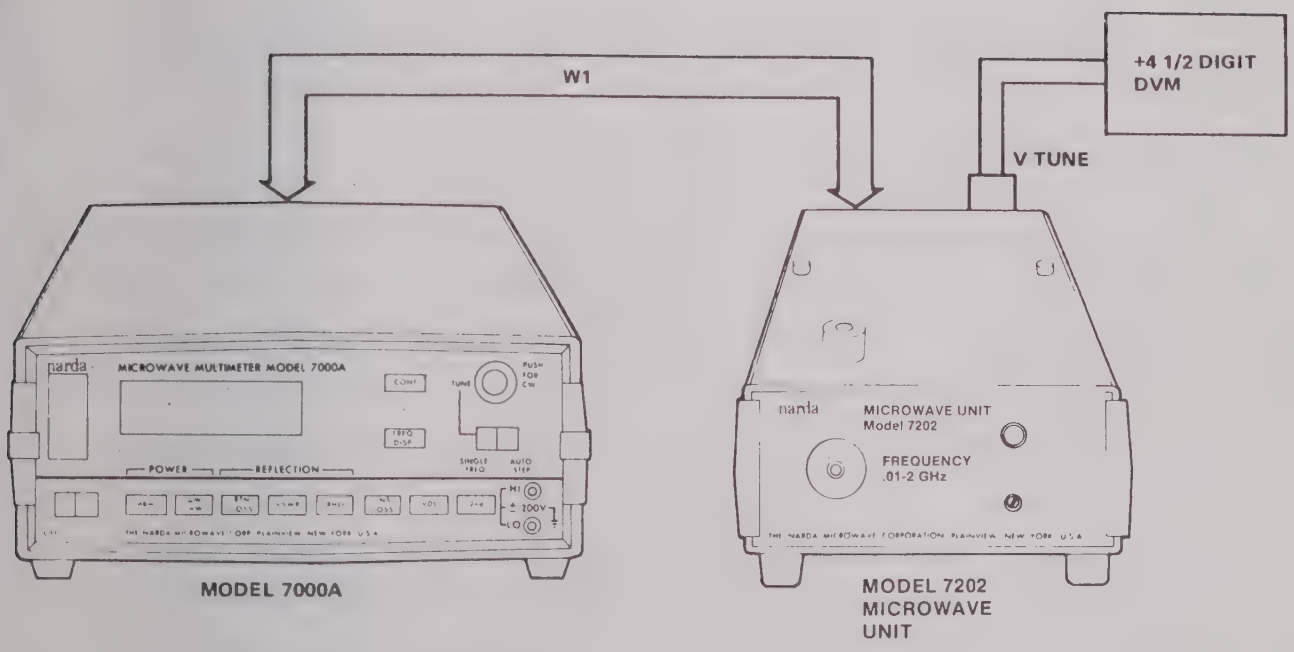


Figure 4-3. Signal Generator Test with 7202 Microwave Unit

NOTE

This is the entry paragraph from the calibration procedure in the 7000A manual (when calibrating the 7000A and 7202 simultaneously).

2.6. Insertion Loss and Isolation Through the 7202. After completing the libration procedures in the microwave multimeter manual as required under 4.2.1. in s manual, "Calibrating a 7202 and 7000A (or 7000A-01) Together," proceed as follows finish calibrating the 7202.

2.6.1. Connect the equipment as shown in Figure 4-4.

2.6.2. Set the signal generator for external tuning voltage control, .01-2 GHz 0 dBm out, internal leveling.

2.6.3. Press the [2nd] and [SIG GEN] buttons on the 7000A. Break the signal path here the RF cable from the signal generator goes into the "TEST SIGNAL IN" nnector on the 7202. Measure and record the power levels at this point as the "UNE" control knob is rotated to move the frequency of the signal across the band.

2.6.4. Reconnect the cable to the "TEST SIGNAL IN" connector. Connect the wer meter to the test port (J1) of the 7202.

2.6.5. Again, measure and record the power levels as the "TUNE" control knob is ated.

2.6.6. Compare the data for the two power levels across the band. Typically, they ould be approximately 8 dB separated. The maximum change should be $\leq$10 dB.

2.6.7. Press [VDC] on the 7000A. Again, use the "TUNE" control knob to move e test signal frequency across the band. The power meter should indicate a power el more than 60 dB below the levels measured in paragraph 4.2.6.5. (on/off ratio $\geq$60).

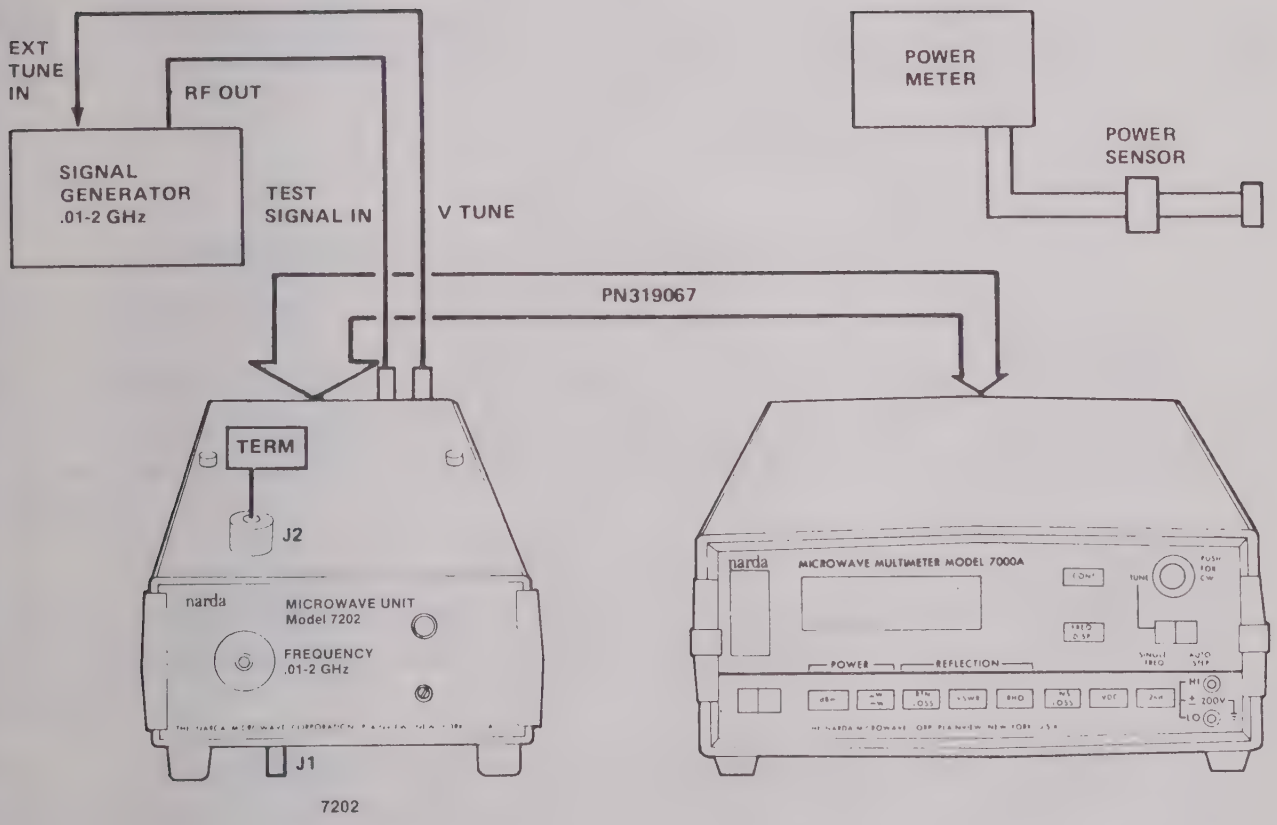


Figure 4-4. Insertion Loss/Isolation Test of 7202

.7. Insertion Loss Test. Proceed as follows:

.7.1. Measure the insertion loss of an attenuator whose attenuation values and WR are precisely known (in the .01 to 2 GHz range). Use the procedures given on the 00A's cover, and follow the instructions displayed on on the 7000A's LCD.

.7.2. Compare data obtained by use of the microwave multimeter (7000A/7202) the corresponding known values of the attenuator. The errors should be within the curacy specifications for the multimeter (± .15 dB (7000A + linearization ecification) ± mismatch uncertainty).

.7.3. Refer to mismatch uncertainty in Section III of this manual for the uation and sample calculation chart of insertion loss mismatch uncertainty.

NOTE

There are no adjustments for the insertion loss test.

.8. Reflection Measurement. Proceed as follows:

.8.1. Measure the reflection magnitude of the attenuator used in the previous sertion loss) test in either [RTN LOSS], [VSWR] or [RHO] display mode. Use the ocedures given on the 7000A's cover and follow the instructions displayed on the 00A's LCD.

.8.2. Compare data obtained by use of the microwave multimeter (7000A/7202) the corresponding known values of the attenuator. The errors should be within the curacy specifications for the multimeter [± 3% (.15 dB) ± directivity error ± smatched error].

.8.3. Refer to mismatch uncertainty in Section III of this manual for the uation and sample calculation chart of reflection measurement uncertainties.

NOTE

There are no adjustments for the reflection measure ment test.

NOTE

No accuracy test for the frequency calibration factors of the power meter has been specified in this section, because many calibration departments do not have the equipment needed to perform an accurate test. Labs that have the necessary equipment usually have their own specified procedure for testing the calibration factors of a power meter. See Table 4-2 for the memory map of the detector. To set the 7000A for a Cal. Factor of 100 simple rotate the "Tune" control full CCW and then Press [FREQ DISP] followed by [dBm] or [µW mW]

4.3. TROUBLESHOOTING.

Do not attempt any troubleshooting task without first reading all of the procedures listed under this paragraph.

4.3.1. Fault Location. If it is not known whether a system fault is caused by the 7000A or the 7202, refer to Section IV, Troubleshooting, paragraphs 4.5 through 4.7 in the 7000 manual. Using the procedures described there will isolate the fault to the defective PC board in either the 7000A or the 7202

4.3.1.1. The fault is in the 7202 if the 7000A (or 7000A-01) and 7202 operate together properly either for all tests in this manual from 4.2.3. through completion of 4.2.5. or for all functional and accuracy tests in the microwave multimeter manual.

4.3.1.2. When troubleshooting several 7000A's (and/or 7000A-01's) and Model 7202 Microwave Units together, the substitution method is probably the most efficient way of localizing a fault either to the 7000A (or 7000A-01) or to the 7202.

4.3.2. Troubleshooting a Faulty 7202. The following comments and charts will aid in troubleshooting, after the fault has been localized to the 7202

3.2.1. Determine which mode(s) is non-functional, and proceed to the appropriate ble. Table 4-3 covers power meter mode problems, Table 4-4 covers signal generator ode problems, Table 4-5 covers insertion loss and reflection mode problems when either mode is accurate and Table 4-6 covers reflection mode problems when the insertion loss mode is accurate.

.3.2.1.1. If either the power meter mode (other than calibration factor error) or the gnal generator mode is defective, the insertion loss and reflection modes will also be efective.

.3.2.1.2. If the problem is in the power meter mode, apply a 1 mW (0 dBm) test gnal level to the detector while the 7000A (or 7000A-01) is in the power meter mode ither [dBm] or [µW mW]). Monitor and compare the waveform at the (A1) board's TP1 the waveform shown in Figure 4-5.

.3.2.1.3. Jumper the digital (A2) board's TP2 to TP3 in the 7000A (or 7000A-01) to btain steady state waveforms.

.3.2.1.4. If the waveform at the (A1) board's TP1 is not correct, open the power ensor assembly. (Remove the four phillips head screws from the top of the assembly nd slide the top section down the cable.) Compare the waveforms to those shown in igure 4-5. Use external triggering on the oscilloscope. Trigger on the negative going dge of the E5 waveform, or the positive going edge of the E6 waveform.

NOTE

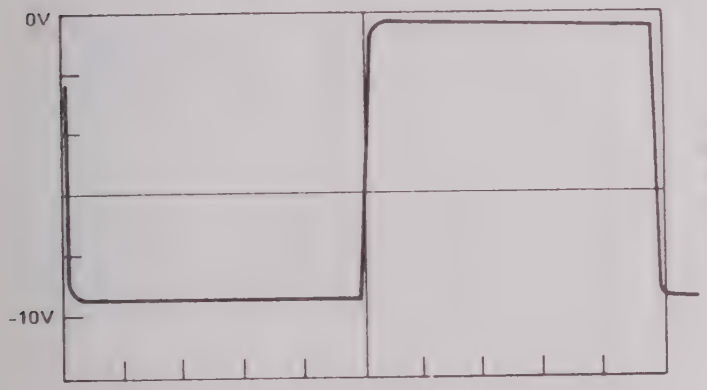
For these waveform comparisons it is not necessary for the unit to be capable of being zeroed, because all amplitudes given are approximate. The zeroing voltage will not change the amplitude by any noticeable degree at this level of tesing.

NOTE

Amplitudes shown are approximate and will vary slightly from unit to unit. The phasing of ail waveforms are shown relative to the negative going edge of the squarewave at E5 (220 HZ clock, $\phi 2$).

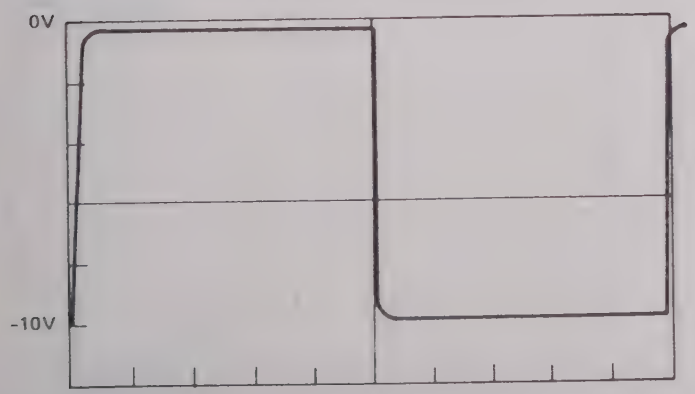
TIME BASE FOR ALL WAVEFORMS: 0.45 msec/DIV

POWER SENSOR: E5: $\phi 2$, 2.0V/DIV



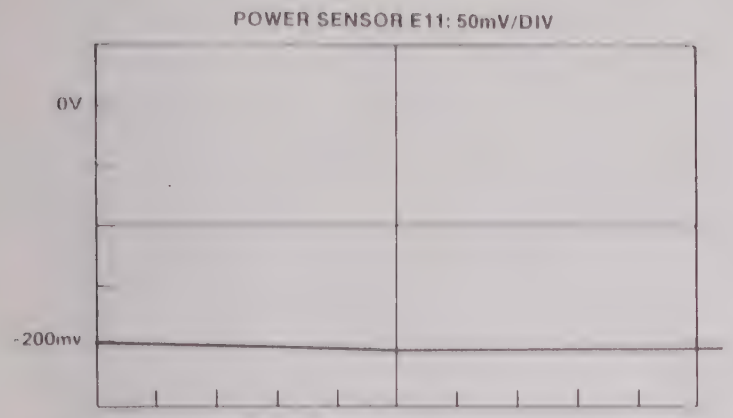
NOTE: MAY ALSO BE MEASURED ON A1PCB AT JUNCTION OF R9 & R10.

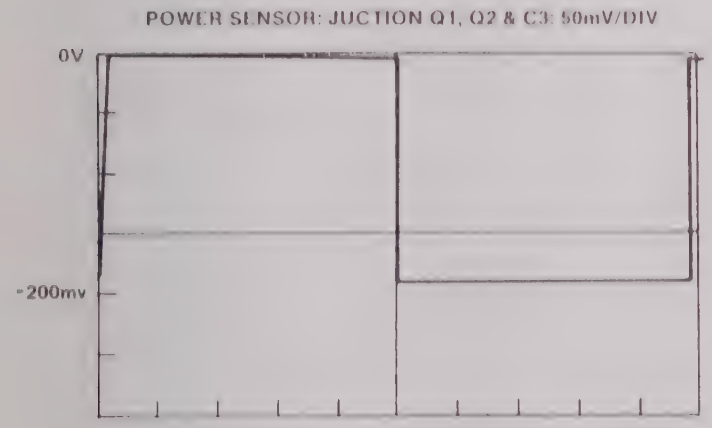
POWER SENSOR: E6: $\phi 1$, 2.0V/DIV

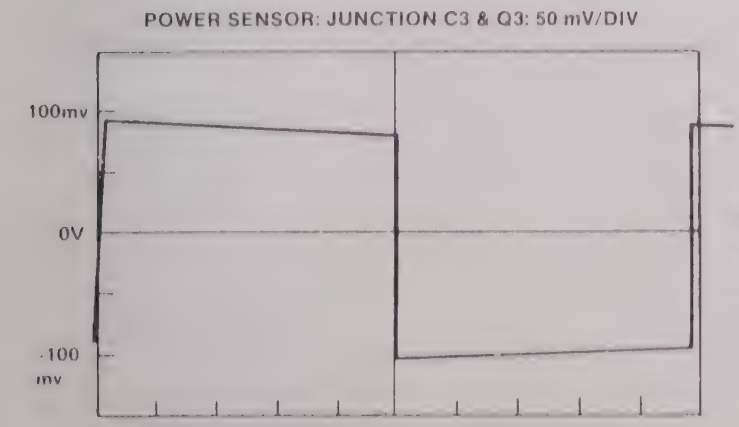


NOTE: MAY ALSO BE MEASURED ON A1PCB AT JUNCTION OF R11 & R14.

Figure 4-5. Waveforms for Power Meter Section: 1 mw into Detector (Sheet 1 of 3)







NOTE:
WAVEFORM ON EM OF Q3 SHOULD BE THE SAME EXCEPT SHIFTED DOWN APPROX. -700mV.

NOTE:
COLLECTOR OF Q3 SHOULD BE AT A DC VOLTAGE LEVEL OF -50 mV to +100mV WITH AN AC SIGNAL LESS THAN $5mV_{p-p}$ (EXCLUDING SWITCHING TRANSIENTS IN SYNC. WITH 220HZ CLOCK

Figure 4-5. Waveforms for Power Meter Section: 1 mw into Detector (Sheet 2 of 3)

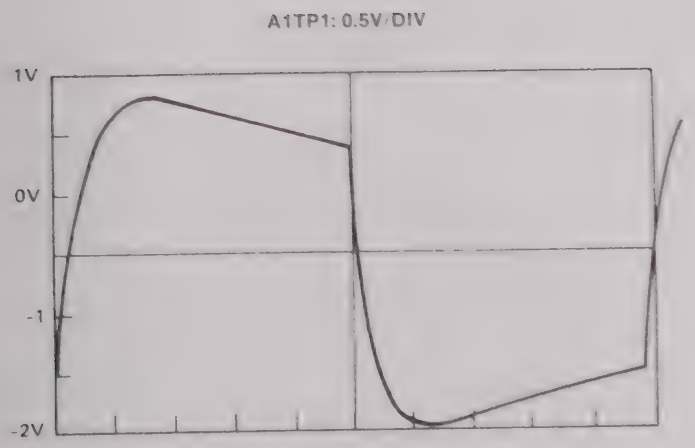


Figure 4-5. Waveforms for Power Meter Section: 1 mw into Detector (Sheet 3 of 3)

Table 4-3

Power Meter Mode Problems*

Fault	Most Probably Causes
not zero	1. A1J2 or A1J1 connection not made solidly. 2. Auto zero voltage not going to Power Sensor (Voltage at junction of A1 R16 and R17 (and power sensor E2 terminal) should step from approximately -100 mV to +100 mV as unit attempts to auto-zero). 3. Power Sensor not removed from RF power source.
essive noise at low power	1. A1J1 or A1J2 connection not made solidly. 2. A1U2 noisy. 3. Q3 on power sensor noisy. 4. Q1 or Q2 on power sensor noisy.
ads power accurately only ow -30 dBm	1. A1U1 defective. 2. Calprm signal not getting to A1U2.
ads power accurately only a power level below speci- d maximum or at all powers cept over a narrow range power levels.	1. U1 defective.
ad power accuractey only er a frequency range less an .01 to 18 GHz.	1. U1 defective. 2. Detector in power sensor assembly defective. Check - sweep the detector for return loss from 2-18 GHz. Check data against specs.

heck 1 mw input level waveforms before using this chart (which assume aveforms were correct).

Table 4-4

Signal Generator Mode Problems

Problem	Most Probably Problems
No power out (J1) and "OSC ON" LED always off.	1. A1J1 connection to 37 pin interconnect cable not solid. Check A1E8 "OSC OFF" signal level (≤ .8V – OSC ON. ≤ 2.4V– OSC OFF) 2. A1Q1 or U3 or CR4 is defective.
"OSC ON" LED does not illuminate but insertion loss is ok.	1. A1Q1 or CR4 defective.
No output power or low power.- "OSC ON" LED functions normally.	1. SPST PIN Switch defective. Check: Remove .141" semi rigid adapter cable assy (W1) and measure power out of PIN Switch. 2. Adapter Cable Assy (W1) damaged. 3. Bridge (A3) input or output connector damaged. Check: 1. Visual check 2. Sweep RTN Loss of Bridge
OSC on LED always on.	1. Q1 or U3 is defective.
Pin Switch always "on".	2. Q2 defective.
V Tune does not change or is erratic	1. U4 is defective. 2. S2 is not seated properly-exercise switch

Table 4-5

ertion Loss and Reflection Mode Problems*

Problem	Most Probable Causes
ual errors in Insertion Loss le are greater than calculated rs.	1. Bridge Test Port (J1) connector damaged. Check: 1. Visual Inspection 2. Sweep return loss of J1 (with bridge input terminated) from .01-2 GHz and compare to 21 dBr specification. 2. Detector connector damaged. Check: same as 2. except spec is 14 dBr return loss below 50 MHz and 21 dBr from 50 MHz to 2 GHz

ssuming neither mode is accurate

Table 4-6

sertion Loss and Reflection Mode Problems**

Problem	Most Probable Causes
rrors greater than calculated alues.	Bridge is defective. Check: Measure directivity of bridge from .01-2 GHz

Assuming unit is accurate in Insertion Loss mode.

Section V

MICROWAVE UNIT REPLACEABLE PARTS INFORMATION
NARDA Model 7202

5.1. INTRODUCTION.

This section provides ordering and repair service information, a list of suppliers and a replaceable parts list for Narda' s 7202 Microwave Unit.

5.2. ORDERING INFORMATION.

To order replacement parts for the Microwave Unit contact the sales department at:

5.2.1. Narda Microwave Corp.
435 Moreland Road
Hauppauge, New York 11788
Phone: 516-231-1700 TWX: 510-221-1867

5.2.2. When ordering replacement parts, supply the following information:
Model and serial number of the equipment
Narda part number
Reference designer
Description.

5.2.3. When ordering components or parts not listed in Table 5-2 a complete description of the part including its function and location should be provided with the model number and serial number of the instrument. State the quantity required when ordering parts.

5.3. CUSTOMER REPAIR SERVICE.

Repair and recalibration of Narda products is performed by the customer service department at the Narda facility shown under paragraph 5.2. It is suggested that you contact Narda Microwave Corp. or your local Narda sales representatives for shipping instructions, or with maintenance information requests.

LIST OF SUPPIERS.

Table 5-1 identifies suppliers listed in numerical sequence according to their manufacturer's supply code number.

Table 5-1

Manufacturer's Supply Code List

anufacturer's Supply Code	Name	Address
00779	Amp Inc.	P.O. Box 3608 Harrisburg, Pa. 17105
01121	Allen-Bradley Co.	1201 South 2nd St. Milwaukee, Wis. 53204
01295	Texas Instruments Inc. Semiconductor & Components Division	135 North Central Expressway Dallas, Tex. 75231
01884	Dearborn Electronics Co. Sprague Electric Co.	P.O. Box 1076 Longwood, Florida 32750
10013	Cornell-Dubilier	Norwood, Mass.
15238	ITT Semiconductor	470 Broadway Lawrence, Ma 01841
15912	Ansley Electronics Corp.	3208 Humboldt St. Los Angles, Ca. 90031
22526	Berg Electronic Div. of E.I. du Pont de Nemours & Co. Inc.	New Cumberland, Pa. 17070
27014	National Semi-Conductor Corp.	2950 San Ysidro Way Santa Clara, Ca. 95051
45177	International Manufacturing Services Inc.	80 Schoolhouse Lane Portsmouth, R.I. 02871
46384	Penn Engrg. & Mfg. Corp.	Doylestown, Pa. 18901
56289	Sprague Electric Co.	North Adams, Mass. 01247
70318	Allmetal Screw Products Co.	Garden City, N.Y. 11530
	Wiltron American Microwave	Damascus, Md.

Table 5-1 (Cont)

Manufacturer's Supply Code	Name	Address
71279	Cambridge Thermionic Corp.	445 Concord Ave. Cambridge, Mass. 02138
72136	Electro Motive Mfg., Co., Inc.	The South Park and John Streets Williamantic, Conn. 06226
72982	Eire Technolgical Products, Inc.	644 W. 12th St. Eire, Pa. 16512
73803	Texas Instruments Connector Systems	34 Forest St. Attleboro, Ma. 02703
80031	Mepco Inc.	Morristown, N.J. 07960
80294	Bourns, Inc. Dept. EM Trimpot Products Div.	1200 Columbia Ave. Riverside, Ca 92507
83330	H.H. Smith	812 Snediker Ave. Brooklyn, N.Y. 11207
91836	Kings Electronics Co. Inc.	40 Marbledale Rd. Tuckahoe, N.Y. 11223
921	Alpha Wire Corp.	711 Lidgewood Ave. Elizabeth, N.J. 07207
95275	Vitramon	Box 544 Bridgegport, Ct. 06601
99899	Narda Microwave Corp.	435 Moreland Rd. Hauppauge, N.Y. 11788

5.5. REPLACEABLE PARTS LIST.

Parts listed in Table 5-2 can be located by referring to the parts location drawings, located in Section VI of this manual.

Table 5-2
Replaceable Parts List

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT	MFG. PART NO.	NARDA PART NO.	QTY.
	BRIDGE, .01-2 GHz			86981000	1
1	COVER, TOP INSEP ASSY	99899	213337	213337	1
2	COVER, BOTTOM PL INSEP ASSY	99899	213343	213343	1
	PCB ASSY	99899	106323	106323	1
C14, 5, C33	. CAP, 470PF, 5%	72136	DM15EA47JO	80115043	3
C15	. CAP, 1000PF, 1000V	56289	35C74A	80122027	1
C25	. CAP, .01UF, 25V	72982	5835-000Y5-U103Z	80123006	1
C26	. CAP, .1UF, 25V	72982	5815-000Y5-U104Z	80123009	1
C32	. CAP, .68UF, 50V	95275	CKO6BX684K	80187072	1
C31	. CAP, .068UF, 50V	95275	CKO6BX683K	80187076	1
C20 1	. CAP, 4.7 UF, 35V, 10%	56289	196D475X90 35JE3	80261011	2
C28	. CAP, .1 UF, 12V	72982	5655-000Y5-F104M	80123002	1 1
C13, 8	. CAP, 47 UF, 20 V, 10%	56289	196D476X90-20PE4	80261012	2
C19	. CAP, 47 UF, 6V, 10%	56289	196D476X90-06JE3	80261013	2
C17	. CAP, 0.082 UF, 80V,10%	56289	292P8239R8	80268008	1
E1-E4, , E7,	. TERM, TURRET	71179	1558-2	80607002	11
J3	. CONNECTOR, 10 PIN	15912	609-1027	81779003	1
J2	. CONN, HEADER, 10 PIN	00779	87588-1	81780003	1
J1	. CONN, RECEPTACLE, D TYPE-37 PIN	00779	206817	81806002	1
TP1,J5	. HEADER ASSY, 1 POS	22526	65508-401	81814003	2
R31,38	. RES, 390 OHM, 1/4W,5%	01121	RC07GF391T	83015039	2
R37 2,R44	. RES, 100 OHM, 1/4W,5%	01121	RC07GF101T	83015025	3
R43	. RES, 12K OHM, 1/4W,5%	01121	RCO7GF123T	80315075	1
R41	. RES, 200K OHM, 1/W, .5%	80031	FER200K	83049412	1
R40	. RES, 198K OHM, 1/8W, .5%	80031	FE10 198K	83139028	1
R34	. RES,1.20K OHM, 1/4W, 5%	01121	RCO7G122T	83015051	1
R17	. RES, 100 OHM, 1/8W, 1%	80031	FE10 100	83049097	1
R16	. RES, 200 OHM, 1/8W, 1%	80031	FE10 200	83049126	1
R33	. RES, 3.6K OHM, 1/4W, 5%	01121	RCO7GF362T	83015062	1
R36	. RES, 51K, 1/4W, 5%	01121	RCO7GF510	83015018	1
R35	. RES, 150K, 1/4W, 5%	01120	RCO7GF151	83015029	1

Table 5-2 (continued)

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT	MFG. PART NO.	NARDA PART NO.	QTY.
A1R22	. RES, 1K OHM, 1/8W, 1%	80031	FE10 1K OHMS 1%	83049192	1
A1R20	. RES, 5.62K OHM, 1/8W, 1%	80031	FE10 5.6K OHMS 1%	83049264	1
A1R15	. RES, 14.7K OHM, 1/8W, 1%	80031	FE10 14.7K OHMS 1%	83049304	1
A1R21	. RES, 15K OHM, 1/8W, 1%	80031	FE10 15K OHMS 1%	83049305	1
A1R10 R11	. RES, 22.6K OHM, 1/8W, 1%	80031	FE10 22.6K OHMS 1%	83049321	2
A1R18	. RES, 26.1K OHM, 1/8W, 1%	80031	FE10 26.1K OHMS 1%	83049327	1
A1R12 R19	. RES, 42.2K OHM, 1/8W, 1%	80031	FE10 42.2K OHMS 1%	83049347	2
A1R9 R14	. RES, 47.5K OHM, 1/8W, 1%	80031	FE10 47.5K OHMS 1%	83049352	2
A1R13	. RES, 56.2K OHM, 1/8W, 1%	80031	FE10 56.2K OHMS 1%	83049359	2
A1R32	. POT, CERMET, 20K	80294	3299W-1-203	83246005	1
A1R23	. RES, VAR., 5K OHMS	80294	83C1D-E12-J13	83266002	1
A1R39	. POT, CERMET, 5K	80294	3299W-1-502	83246003	1
A1U2,U3, U4	. IC, LF355N	27014	LF355N	84783000	3
A1CR2, CR3	. DIODE, 1N4148	15238	1N4148	8483000	2
A1CR5	. DIODE, 1N5242B	15238	1N5242B	84743002	1
A1Q1	TRANSISTOR, 2N4124	56289	2N4124	89018036	1
A1Q2	. TRANSISTOR, 2N4126	56289	2N4126	89018037	1
A1S2	SWITCH, 2PST			83723002	1
A1XU2, XU3, XU4	. IC SOCKET, 8 PIN	73803	C93-08-10	89075000	3
A1XU1	. IC SOCKET, 20 PIN	73803	C93-20-10	89075003	1
MP3	ADAPTER ASSY, TYPE N TO SMA	99899	205542	20552	1
MP4	REAR PANEL SUB ASSY	99899	319431	319431	1
MP5	FRONT PANEL	99899	319409	319409	1
MP6	BRACKET, BRIDGE	99899	213395	213395	1
W1	CABLE ASSY	99899	213393	213393	2
W2	CABLE ASSY	99899	319962	319962	1
MP8	SIDE EXPANDER	99899	318558	318558	2
MP9	SCREW CAPTIVE	99899	418223	418223	2

Table 5-2 (continued)

EF. SIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT	MFG. PART NO.	NARDA PART NO.	QTY.
	PIN SWITCH, SPST			86978001	1
	PWR SENSOR ASSY W/4 1/2 FT. CABLE AND PROM	99899	319085	319085	1
	PWR SENSOR ASSY W/10 FT. CABLE AND PROM	99899	319337	319337	1
	PWR SENSOR ASSY W/15 FT. CABLE AND PROM	99899	319338	319338	1
	PWR SENSOR ASSY W/60 FT. CABLE AND PROM	99899	319881	319881	1
	. PCB ASSY, PWR SENSOR	99899	212632	212632	1
C6	. . CAP, 75PF, 5%	72136	DM15E 750J0	80115024	1
C5	. . CAP, .00UF, 500V	10013	BYA 10D1	80128001	1
C4	. . CAP, .01UF, 500V	10013	BYA 6S1	80128004	1
C7	. . CAP, 22UF	56289	L96D226X90-15A1	80230034	1
C2,C3	. . CAP, 2.2UF,50V	01884	LP88A1A225K	80274001	2
R6	. . RES, 200 OHM, 1/8W, 1%	80031	FE10 200Ω,1%	83049126	1
R7	. . RES, 301 OHM, 1/8W, 1%	80031	FE10 301Ω,1%	83049143	1
R8	. . RES, 499 OHM, 1/8W, 1%	80031	FE10 499Ω,1%	83049164	1
R5	. . RES, 13K OHM, 1/8W, 1%	80031	FE10 13Ω,1%	83049299	1
R6,R3	. . RES, 16 OHM, 1/8W, 1%	45177	IMS 3B-2-16	83267001	2
R4	. . RES, 10K OHM, 1/8W, 1%	45177	IMS 3B-2-10K	83267002	1
CR1 2	. . DIODE, IN4148	15238	IN 4148	84830000	2
E1→	. . TERMINAL, TUBULAR	91833	1562-2	87118002	9
Q3	. . TRANSISTOR, 2N3117	27014	2N3117	89018011	1
Q1,Q2	. . TRANSISTOR, 2N5638	04713	2N5638	89018103	2
	. HOUSING, FRONT ASSY	99899	212713	212713C	1
	. . HOUSING, FRONT	99899	214714	212714C	1
	. HOUSING, REAR	99899	212715	212715C	1
13	SCR, PAN HD, #6-32x2 LG	70318	Screw, Cres Cross Rec Pan Hd #6-32 x 2	551957038	4
19	STRAIN RELIEF BUSHING	99899	72519000	72519000	1
J4	REC, BNC, UG-1094/U	91836	KC-79-35 (TR-5 FINISH)	815240000	2
1	LED, GREEN	99899	848310000	848310000	1

Table 5-2 (continued)

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT	MFG. PART NO.	NARDA PART NO.	QTY.
MP10	SPRING, COMPRESSION	99899	94012000	94012000	2
MP11	SPACER	99899	95630003	95630003	4
MP12	FEET	99899	95630015	95630015	4
MP16	WASHER, FLAT #4	70318	MS15795803	515795803	8
MP21	WASHER, FLAT #6	70318	MS15795805	515795805	18
MP24	WASHER, FLAT #2	70318	MS15795802	515795802	2
MP18	WASHER, LOCK INT.	70318	MS15333070	89111000	2
MP17	WASHER, LOCK #4	70318	MS35338135	535338135	12
MP14	WASHER, LOCK #6	70318	MS35338136	535338136	12
MP23	SCR, PAN HD, #2-56x5/16 LG	70318	MS51957006	551957004	2
MP15	SCR, PAN HD, #4-40x1/4 LG	70318	MS51957013	551957013	13
MP20	SCR, PAN HD, #6-32x1/2 LG	70318	MS51957030	551957030	8
MP25	LOCK NUT ASSY	99899		419064	1

Section VI

MICROWAVE UNIT SCHEMATIC AND PARTS LOCATION DRAWINGS
NARDA Model 7202

6.1. INTRODUCTION.

This section provides schematic, parts location and exploded view drawings of the Model 7202 Microwave Unit.

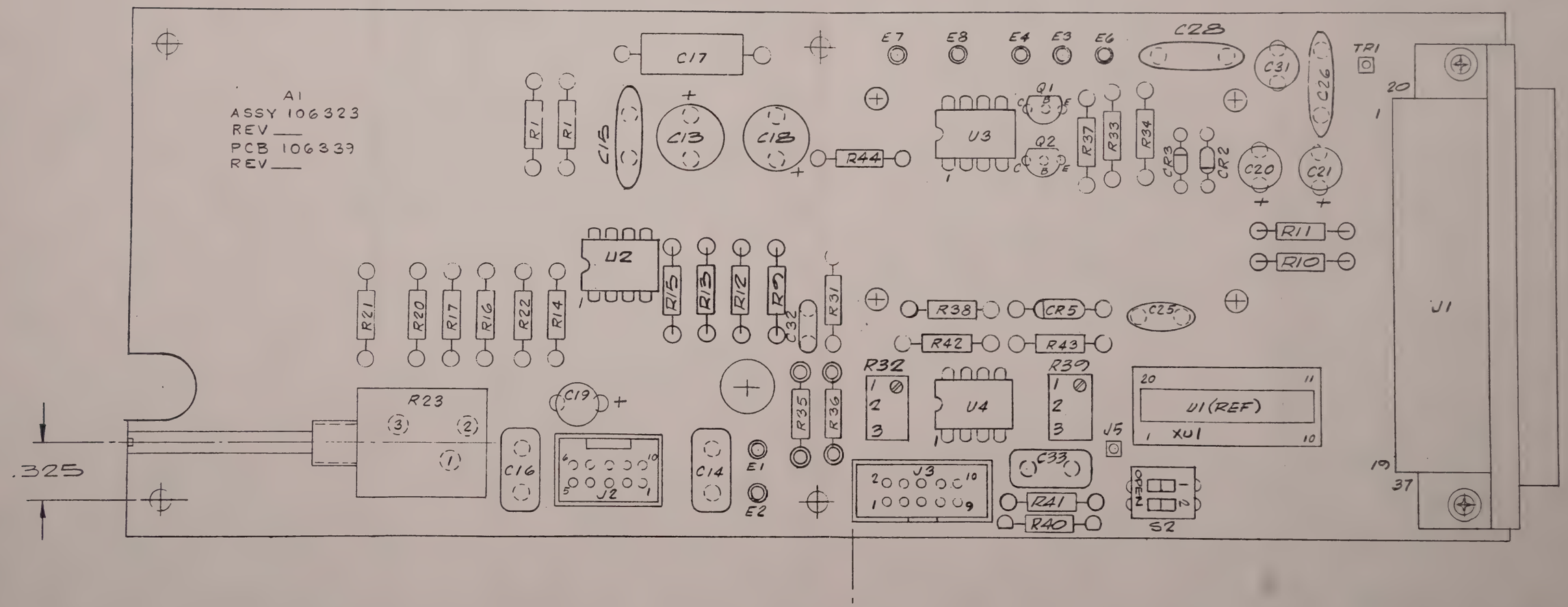
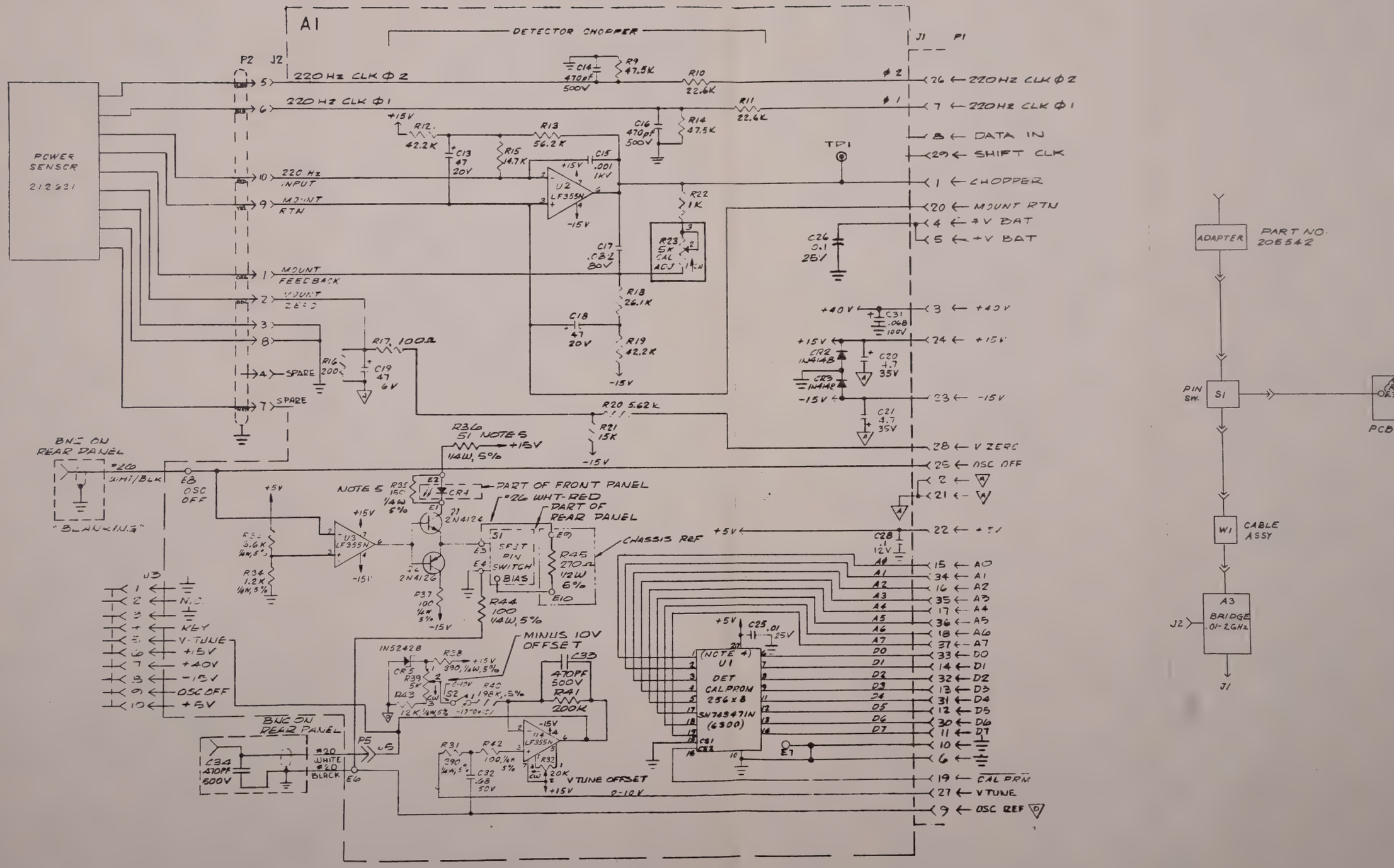


Figure 6-1. Schematic and Parts Location Drawing Model 7202 Microwave Unit (Sheet 1 of 2)


A1
DETECTOR CHOPPER
P2 J2
J1 P1
POWER SENSOR 212621
220 Hz CLK Φ 2
220 Hz CLK Φ 1
220 Hz INPUT
MOUNT RTN
MOUNT FEEDBACK
MOUNT ZERO
SPARE
SPARE
R9 47.5K
R10 22.6K
R11 22.6K
R12 42.2K
R13 56.2K
R14 47.5K
R15 14.7K
R16 200Ω
R17 100Ω
R18 26.1K
R19 42.2K
R20 5.62K
R21 15K
R22 1K
R23 5K CAL ADJ
R34 1.2K 1/4W, 5%
R35 150 1/4W 5%
R36 51 NOTE 5 1/4W, 5%
R37 100 1/4W 5%
R38 390, 1/4W, 5%
R39 5K
R40 198K, 1%
R41 200K
R43 12K, 1/4W, 5%
R44 100 1/4W, 5%
R45 270Ω 1/2W 6%
C13 47 20V
C15 .001 1KV
C16 470pF 500V
C17 .082 80V
C18 47 20V
C19 47 6V
C20 4.7 35V
C21 4.7 35V
C25 .01 25V
C26 0.1 25V
C28 1 12V
C31 .068 100V
C32 68 50V
C33 470PF 500V
C34 470PF 500V
U2 LF355N
U3 LF355N
U1 DET CALPROM 256x8 SN74S471N (6300)
CR1 2N4124
CR2 IN4148
CR3 IN4148
CR5 IN5242B
Q1 2N4124
Q2 2N4126
S1 SPST PIN SWITCH
S2
TP1
+15V
-15V
+40V
+5V
+5V
-15V
-15V
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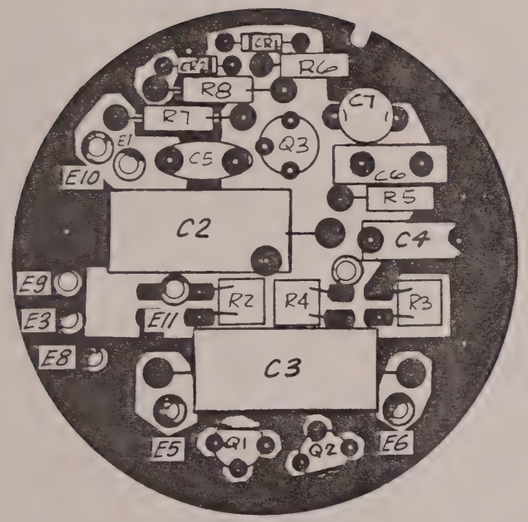
+15V
+5V
+5V
-15V
+15V
+15V
+5V
+5V
+5



* THICK FILM CHIP RESISTOR

Figure 6-2. Schematic and Parts Location Drawing
Power Sensor Assembly PC Board

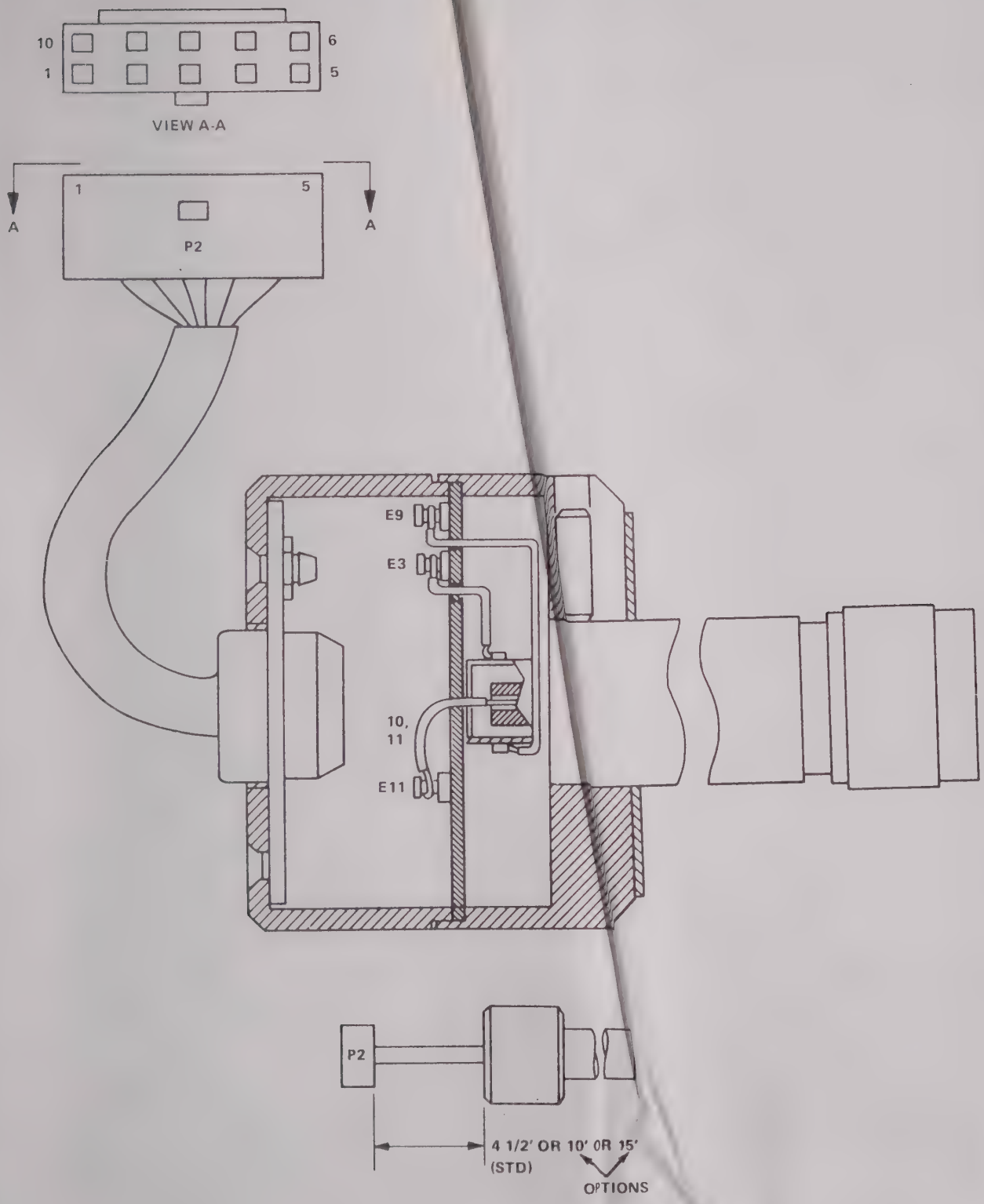


Figure 6-3. Parts Location Drawing Power Sensor Assembly

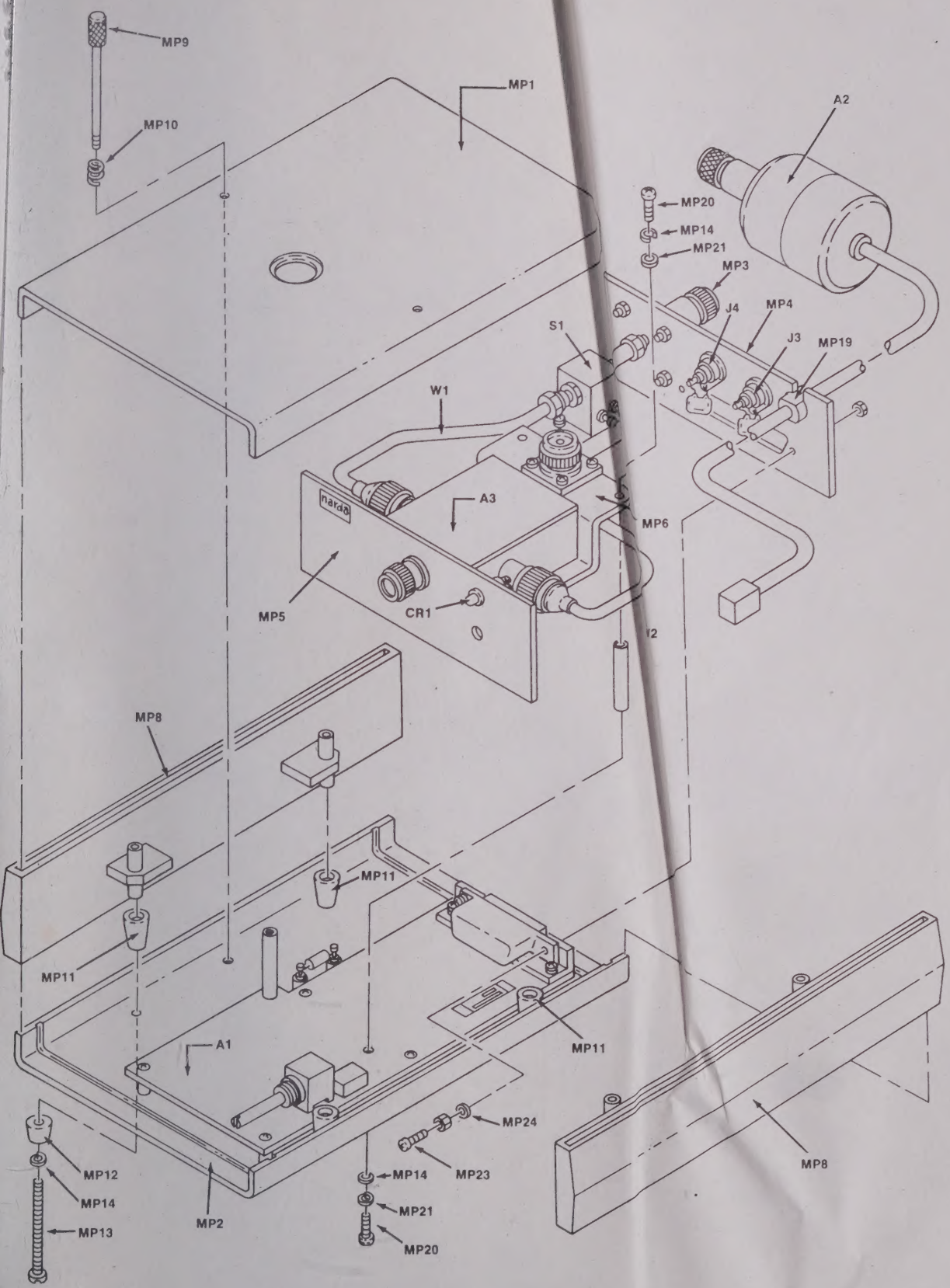


Figure 6-4. Exploded View Model 7202 Microwave Unit

ACCOPRESS®

25170	YELLOW
25171	BLACK
25172	LIGHT BLUE
25173	DARK BLUE
25174	LIGHT GRAY
25175	LIGHT GREEN
25176	DARK GREEN
25177	TANGERINE
25178	RED
25179	EXECUTIVE RED

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